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Quantitative aspects of the growth of audiovisual equipment in the public schools of the United States during the period 1930-1960 are reported. The buildup of audiovisual equipment and materials in education is one of the principal preconditions for a technological revolution in education. Items of audiovisual equipment are considered one category of indicators of the growth of instructional technology in American education.

The types of equipment selected for the analysis of growth patterns are items of audiovisual equipment commonly used in the classroom for instruction. Equipment selected includes motion picture projection equipment, still picture projection equipment, sound equipment, and broadcast reception equipment. Procedures used to develop the growth curves are analysis of published studies, analysis of unpublished material, confidential survey of the audiovisual industry, coordination with the Godfrey Study (a nationwide survey of the use of audiovisual media in U.S. public schools), consultation with knowledgeable individuals, and estimation procedures. The main limitation of the study is the nature of the data.

An analysis of the growth curves of the audiovisual equipment indicates that the teacher equipment ratios are not sufficiently low to justify the conclusion that the educational culture is in the takeoff phase of a revolution. The authors recommend seven items of equipment as the threshold for a revolutionary takeoff (16mm. or 8mm. sound motion projector, slide/filmstrip projector, overhead projector, radio receiver, record player, tape recorder, and TV receiver). There should be one piece of each of five of these seven items of equipment for every five teachers in America, and one language laboratory per school.

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TECHNOLOGICAL DEVELOPMENT PROJECT

headquarters:

LOS ANGELES FACILITY
School of Education
University of Southern California
Los Angeles 7, California

WASHINGTON FACILITY
National Education Association
1201 Sixteenth Street, N. W.
Washington 6, D. C.

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22

Occasional Paper No. 6

STUDIES IN THE GROWTH OF INSTRUCTIONAL TECHNOLOGY, I: AUDIO-VISUAL INSTRUMENTATION FOR INSTRUCTION IN THE PUBLIC SCHOOLS, 1930--1960

A BASIS FOR TAKE-OFF

by

James D. Finn
Donald G. Perrin and
Lee E. Campion

A Report Prepared for the

TECHNOLOGICAL DEVELOPMENT PROJECT

of the

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School of Education
University of Southern California
Los Angeles, California
Mailing address: 924 West 37th Street
Los Angeles 7, California

The Washington office of the Project is located in the

National Education Association
1201 16th Street, N.W.
Washington 6, D.C.

Principal Investigator: James D. Finn (Los Angeles)
Associate Investigator: Lee E. Campion (Washington)

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Donald P. Ely
Donald G. Perrin
Ronald J. McBeath (July to Nov., 1961)
Carole Prenter (Summer 1961, 1962)
Barbara Rasin

Lt. Col. John T. Quick, Military Consultant

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A study such as this represents the combined efforts of a number of people and the assistance, in one way or another, of many more. We would particularly like to acknowledge the help received from the Project Advisory Committee, and the U.S. Office of Education. We also wish to call attention to Table V in Section III which lists the people interviewed one or more times during the course of the study. Without their generous assistance, this report would not have been possible.

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James D. Finn
Donald G. Perrin
Lee E. Campion

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TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS iv

SECTION I. OVERVIEW AND RATIONALE OF THE STUDY 1
  The Theoretical Position 1
  An Analog Model of Growth and Development 2

II. THE DEMOGRAPHY OF PUBLIC EDUCATION AS A BACKGROUND FOR TECHNOLOGICAL GROWTH 11
  Schools and School Districts 12
  Students and Teachers 14
  Analysis 18

III. METHODOLOGY 21
  Purpose of the Study 21
  Methodology 21
  Limitations 28

IV. 16MM SOUND MOTION PICTURE PROJECTORS 31
  Significance of the 16mm Sound Motion Picture Projector as an Indicator 31
  The Process of Estimation 32
  Total Number of Projectors in the Public Schools 35

V. STILL PROJECTORS 39
  Slide/Filmstrip Projectors 39
  Methodology 39
  Total Number of Slide/Filmstrip Projectors in the Public Schools . 44
  Opaque Projectors 44
  Overhead Transparency Projectors 45
  Still Projection Equipment Considered as a Whole 45

TABLE OF CONTENTS (continued)

Page

SECTION VI. SOUND REPRODUCING AND RECORDING EQUIPMENT 47
- Methodology 47
- The Growth Pattern of Sound Equipment 47

VII. BROADCAST RECEPTION EQUIPMENT 52
- Methodology 52
- Growth Patterns of Radio and TV Receivers 53

VIII. THE COST OF EQUIPMENT--INVESTMENT IN INSTRUCTIONAL TECHNOLOGY 57
- The Method of Deriving the Cost of the 16mm Sound Motion Picture Projector 57
- The Cost Pattern of the 16mm Sound Picture Projector 58
- Method of Deriving the Total Investment Figures 58
- The Growth Pattern of Overall Audio-Visual Equipment Investment 61
- A Brief Investment Comparison 63

IX. EQUIPMENT FOR THE TEACHER--A COMMENT 64
- An Overall Analysis of the Growth Curves 65
- Growth and Take-Off 70
- The Threshold of Take-Off 71

BIBLIOGRAPHY 73

APPENDIX A. DEMOGRAPHIC STATISTICS 79

APPENDIX B. CONFIDENTIAL SURVEY FORM 85

APPENDIX C. BASIC DATA 89

LIST OF TABLES

Table		Page
I	Growth of Schools and School Districts, 1930-1960	81
II	Pupils, Teachers, and Attendance in the U.S. Public Schools, 1870-1960	82
III	Studies and Reports of a General Nature Used in the Preparation of the Growth Curves	24
IV	Responses to Confidential Survey	27
V	Individuals Consulted During the Study	29
VI	Finn-Campion Survey of Annual Equipment Sales, 1962	91
VII	Godfrey Survey (B.S.S.R.) of Audio-Visual Equipment in the U.S. Public Schools, 1961	92
VIII	Golden Study of Motion Picture and Filmstrip Projectors in U.S. Elementary Schools (1942), High Schools and Colleges (1941)	93
IX	Quantity and Value of Equipment Shipped by U.S. Manufacturers in Three Census Years	94
X	Equipment in Public School Systems Extrapolated from National Education Association Survey, 1946	95
XI	Equipment in Public School Systems Extrapolated from National Education Association Survey, 1953-1954	96
XII	Annual Production of 16mm Sound Motion Picture Projectors Related to Number of Units in the U.S. Public Schools, 1936-1962	97
XIII	Annual Production of Filmstrip and Slide Projectors, 1946-1962	98
XIV	Total Number of Language Laboratories in the U.S., 1950-1962	99
XV	Production of Radio and Television Receivers, 1922-1959, Compared to Purchases by U.S. Public Schools	100
XVI	Television Broadcasting Stations, 1941-1961	101
XVII	Average Price of 16mm Sound Film Projectors, 1931-1962	102

LIST OF TABLES (Continued)

Table		Page
XVIII	Replacement Costs of Nine Items of Audio-Visual Equipment in 1962 Dollars	60
XIX	An Index to Cumulative Growth of Audio-Visual Equipment in the Public Schools, 1936-1962	104
XX	Comparative Growth Figures for Audio-Visual Equipment in the Public Schools, 1936-1962	105
XXI	Number of Teachers per Unit of Audio-Visual Equipment in the U.S. Public Schools, 1946-1962	106
XXII	Number of Units of Audio-Visual Equipment per 100 Teachers in the U.S. Public Schools, 1946-1962	107
XXIII	Comparative Teacher-Equipment Ratios, 1960-1962	108

LIST OF FIGURES

Figure — Page

1. Growth of Schools and Districts: 1930-1960 13
2. High School Graduates: 1870-1960 15
3. Growth Patterns, Teachers and Pupils: 1870-1960 16
4. Pupil/Teacher Ratio: 1870-1960 17
5. Increase in Pupil Attendance: 1870-1960 19
6. Sales Patterns: 16mm Sound Motion Picture Projectors: 1936-1962 .. 34
7. 16mm Sound Motion Picture Projectors in Use in the Public Schools: 1936-1962 37
8. Some Growth Comparisons 38
9. Annual Sales and Purchases of Slide and Filmstrip Projectors: 1947-1962 40
10. Annual Increase Slide/Filmstrip Projectors in Public Schools: 1947-1962 41
11. Slide/Filmstrip Projectors in Public Schools: 1946-1962 42
12. Still Projectors in the Public Schools: 1936-1962 43
13. Sound Equipment in the Public Schools: 1936-1962 48
14. Language Laboratories in the Public Schools: 1955-1962 50
15. Radio and Television Receivers in the Public Schools: 1936-1962 54
16. Growth of Television Stations: 1946-1961 56
17. Average Cost of 16mm Projectors: 1936-1962 59
18. Cumulative Growth of Audio-Visual Equipment in Public Schools: 1936-1962 62
19. Number of Teachers Per Unit of Audio-Visual Equipment: 1946-1962 66
20. Number of Units of Audio-Visual Equipment Per 100 Teachers: 1946-1962 68

STUDIES IN THE GROWTH OF INSTRUCTIONAL TECHNOLOGY: I: AUDIO-VISUAL INSTRUMENTATION FOR INSTRUCTION IN THE PUBLIC SCHOOLS, 1930-1960--A BASIS FOR TAKE-OFF

SECTION I

OVERVIEW AND RATIONALE OF THE STUDY

The term, "economic growth," and its associated term, "economic development," are heavily embedded in any recent American--or, for that matter, international--discussion of problems of domestic or international economics, war and peace, unemployment in West Virginia or starvation in the northeastern area of Brazil. To the United States, economic growth is a continuing challenge; it is an amazing phenomenom in the Common Market countries and West Germany; it is a conflicting ideal as well as a serious problem for many of the underdeveloped countries of the world; it is the basis of a great contest between the United States and the Soviet Union.

Economic growth is a world-wide problem. Within the broad range of discussion of the subject, although there is much disagreement, certain patterns of thought can be seen emerging. The study reported here is a study of economic or technological growth within a small division of a large unit of the public sector of the American economy--education. This study, an analysis of the acquisition of certain types of technical equipment by the public school system over the last thirty years, can be related to the emerging patterns of thought concerning economic growth.

The Theoretical Position

The starting point for out argument is based on a proposition advanced by one of the authors of this paper in an earlier article (19). In this view, education, as a sector of national life, has, for the most part, been cut off from the technological advances enjoyed by industry, business, the military establishment, etc. The American educational enterprise exists out of technological balance with great sectors of the society. As such, it can be viewed as a relatively primitive or underdeveloped culture existing between and among highly sophisticated technological cultures. As Dr. George Gerbner says, "the public school system is the last stronghold of folk culture in America."[1]

---

[1] Personal communication to James D. Finn.

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It is with the relation of technological development and the educational enterprise that the Technological Development Project is concerned. Much has been written about the actual or potential technological revolution taking place or about to take place within education. The folk culture of American education is in the process of change. The degree of change and its nature are subject to argument both within and without professional education. The revolution, potential or actual, has not yet been adequately described; even the values inherent in the technological changes now occuring in education are the subject of debate, some of which can only be described as high-temperature debate.

It is the mission of the Technological Development Project to attempt an assessment of this technological revolution in education. As indicated above, we view the present educational culture as analogous to an underdeveloped culture under assault by technology from the co-existing, highly sophisticated cultures of industry, business and even certain sectors of the government, such as the military and scientific sectors.

If this proposition is accepted as true (and the arguments for such an acceptance are indeed persuasive), then the emerging patterns of thought regarding economic growth and development of underdeveloped cultures can be used to provide an analog model for the consideration of the technological revolution in education. This we propose to do briefly as the theoretical background for the study reported here.[2]

An Analog Model of Growth and Development

In this brief discussion, we propose to advance a series of statements starting from the general position presented in the previous section. We do this to make our position explicit and in the hope that the figures reported in the body of the study will have more meaning to interested readers. The statements have been developed from an examination of some of the students of economic growth and development, including Galbraith (29), Ward (70), Rostow (56), Cottrell (11), Myrdal (46), and Kybal (44). The selection, synthesis, organization and reconception is, however, the responsibility of one of the writers[3] of this paper.

---

[2] This entire view will be elaborated in the final report of the Project

[3] James D. Finn

The general model which we intend to follow in discussing this and other examples of the growth and development of technology in education is as follows:

1. Education, until very recently, and, in fact, right up to the present moment in American history, is part of the poor sector of American society which includes publicly rendered services such as the police, metropolitan services, social services, etc. This means that education has not had a comparable investment in its three hundred year history as that enjoyed by business, industry and, since World War II, by the military and scientific establishments. This situation is referred to by Galbraith in his theory of social balance.

2. The result of this parsimony toward education is apparent enough in the much-commented-upon situations of the last twenty years, such as the shortage of teachers and classrooms.

3. More specific results of this national policy of keeping education at the subsistence level can be shown to affect the nature of education itself. An underdeveloped, poor culture is a non-technological culture. Science and technology cannot successfully be applied to a culture, as Ward has shown (70: 86--110), without an investment of twelve to fifteen per cent of the national income. Technology is expensive. Since the investment in all instructional materials and equipment has ranged from one-fifth to one-third of this amount (of the total investment in American education which also does not meet this standard), the result has been that the educational culture is and has been a non-technological culture where energy and output have been thought of in coolie labor terms.

4. An objection can be raised that investment is not the only dimension of a technological culture; that there must also be, in the case of education, for example, a science of learning and a technology of instruction. This is true. However, as Ward says, " . . . if technology is the key to producing more output with less use of resources--productivity--then capital--or saving--is the only key to technology." (70: 95) The test of this reasoning is to examine the amount invested in the last thirty years, for example, in research and development in all areas of education. It is so infinitesimal that it does not appear on the charts of the National Science Foundation.[4]

A science of learning and a technology of instruction cannot exist without a research and development program to create them. Infinitely more is known, for example, about the internal combustion engine or the flow of electrons in semiconductors than is known about the process of reading--and reading is one area in education which has been subjected to, comparatively speaking, a sustained research effort.

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[4] The TDP is publishing another study on R & D investments in instructional technology as a companion to this study.

5. There are various measures of technological sophistication that can be applied to any culture. These would certainly include the amount of tooling (or energy) available per capita; the quantity and quality of scientists, engineers, and managers; the investment available for R and D, etc. The higher a culture rated on such a series of scales, the more technological sophistication it could be said to have. Since such a concept presupposes a pattern of growth, it follows that the more sophisticated the technological environment, the more the expectation of and aspiration for further technological growth would be orienting values in the culture because of the environment.[5]

6. A specific result of economic scarcity in the educational sector and the consequent low level of technological development is that no expectation arises among educational workers at all levels nor among educational policy and decision-makers (boards, superintendents and presidents) which would require greater technological development. For example, very few demands arise for technical improvements in anything but peripheral matters such as business office accounting; a modern logistics of instruction does not exist either in practice or in the theories under which superintendents and presidents operate; professional organizations of teachers are, for the most part, concerned with working conditions not much beyond the level of hand labor.[6] This lack of expectation and aspiration for technological development probably also accounts, in a large part, for the often noted lag between innovation and research in education and its general application. A sophisticated technological culture integrates research and development with application; a primitive culture sees little or no connection.[7]

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[5] An excellent discussion of the relation of energy systems and cultural value systems may be found in Cottrell (11).

[6] The platform and resolutions document of the National Education Association adopted at the Denver Convention of 1962 contains a statement recognizing the new media and encouraging teachers to work for the provision of such facilities in schools. (NEA Handbook, 1962-63, p. 57). In addition, such departments as the Department of Audio-Visual Instruction have worked in this direction for years. However, the generalization is still fair.

[7] It is recognized that there are other factors operating in this complex situation: The nature and quality of existing research, for example; the now healing twenty-five year split between experimental psychology and education; the general conviction which comes from sources other than concepts of economic scarcity that, somehow, people and technology cannot be mixed in a highly personalized educational process; the influence of the literary, as opposed to the scientific, tradition in education; and the blocks to innovation noted by Brickell (8). The economic factor, however, is probably the most important one in the mix.

7. We thus have a relationship existing between the economics of the educational situation--an economics of scarcity--and the relatively low level of technological sophistication in the educational sector. This situation, in turn, produces a low level of expectation of and aspiration for further technological growth and, instead, produces input/output productivity concepts associated almost solely with manpower arrangements.[8]

8. However, one of the great facts of life in the modern world is that traditional cultures do not stand still. The traditional culture of education is no exception. Like Sierra Leone and Indonesia, the traditional folk culture of education is under pressure from co-existing technological cultures; as we indicated above, in the case of education, the pressuring cultures represent the private sector of the economy--business and industry--and the related public-private sectors of the military and scientific establishments. Increasingly, for various reasons,[9] the linkage between the technological sectors and education has become greatly strengthened and much more efficient. If linkage is thought of in its cybernetic sense, this linkage between cultures, like the linkage between machines, improves communication between them by making them more like each other.[10]

9. In considering the problem of the transition of traditional cultures into growth (technological) cultures, Rostow (56) has identified five stages that seem to be fairly well accepted. For example, Ward (70) uses the Rostow concepts. Assuming pressure on the educational sector for technological development comes through linkage with the other sectors (society?) and will result in a transition into a technological

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[8] An example of this type of thinking was the introduction of so-called teachers' aides on an experimental basis a few years ago. All this succeeded in doing was to add to the manpower pool at a cheaper rate to help conduct the business of education. The use of parents and "educated" women in the community as paper readers and the hiring of PTA members to score standardized tests are other examples. None of these arrangements were adding specialized techniques or techniques of several grades to support the teacher as the doctor is now served by several grades of technicians, although this has been the analogy used. In fact, many of the so-called team teaching plans are simply manpower arrangements which include crude attempts at the division of labor. Much more needs to be said on this subject.

[9] Sputnik, the coming shortages of personnel in science-based industries, the status level achieved by scientists since World War II causing them to operate in non-scientific sectors such as public education, the drive in the technical industries for diversification which causes them to look to education for new markets, the deliberate direction of the power of the Ford Foundation, etc.

[10] The writer is indebted to John Wilkinson of the Center for the Study of Democratic Institutions for this insight. JDF

culture, we propose to argue that a rough analogy with Rostow's stages of growth will occur within American education. The significance of Rostow's stages in the educational setting can then be applied to the results of the study reported in this paper.

10. Rostow's five stages of growth of a traditional culture into a high-order technological culture are: (1) the traditional society, (2) the preconditions of take-off, (3) the take-off, (4) the drive to maturity, and (5) the age of high mass-consumption. Their relation to the educational situation will be discussed immediately below. For the moment, it is sufficient to state the basic thesis of this paper, namely, that American education, considered as a culture in transition, is now beginning the take-off stage into a high-order, high-energy culture, and that it is the first educational system in the world to reach this stage. The study reported herein concerning the "tooling-up" of American education will present evidence from which this thesis can be argued.

It is also recognized, however, that the growth indicators (equipment) reported upon are necessary but not sufficient for clearance all the way through the take-off stage. There are others upon which little evidence exists, either because such evidence is hard to come by or because the indicators themselves have not developed enough to be significant. The most important of these are in the general area of technical-professional manpower. There are others, such as materials, facilities and public and professional attitudes. We will deal with some of these other indicators in subsequent papers.

However, recognition that some of the indicators, such as manpower, have not yet reached a growth point which suggests the educational sector is ready for take-off, does not require a conclusion that education in fact, is not in take-off. Most writers on the subject point out that, in an economy in general, the leading sectors (from the point of view of growth) change from time to time. Following the analogy used throughout this paper, it can be argued that such is the case within the sector of education--that various sub-sectors will exchange lead positions in growth with changing conditions. Thus, development in technical-professional manpower will probably follow, not precede, machine development. If this is true, the manpower situation ought to straighten itself out during the take-off period.

11. To indicate more specifically why the evidence submitted in this study may be considered at least a partial indication that the educational sector is ready for take-off,[11] a review of Rostow's conditions will be helpful. Concerning the traditional society he said, ". . . a ceiling existed on the level of attainable output per head. This ceiling resulted from the fact that the potentialities which flow from modern science and technology were either not available or not regularly and systematically applied." (56: 4) This, we maintain, has been the condition of American education in the recent past. The second stage, preconditions for take-off, included two general factors--certain psychological (political) changes in parts of the population which made people and institutions friendly to economic growth and the building up of social overhead capital--transport, communications, education, etc.--including the means for mobilizing capital, such as banks. When the critical mass of the take-off period is reached, social overhead capital has been developed sufficiently, political institutions and power are oriented toward modernization and, most important, "the proximate stimulus was mainly . . . technological" (56: 8).

After take-off, the society enters stage four, the drive to maturity. The economy expands "into more refined and technologically often more complex processes" (56: 9); investment for tools, etc., continues at a high rate of from 10 to 20 per cent and, as the society reaches maturity, it can apply its technological resources anywhere it chooses. This, of course, is what happens as the stage of high consumption and the affluent society is reached.

12. In the previous discussion, the concept of linkage was introduced--the notion that the educational culture was pressured in the technological direction by the industrial and other private and public-private sectors of the economy. This concept has direct relevance to the argument that education is now at the take-off stage. Rostow indicates that the pre-conditions for take-off in the general case (the case applicable to the most cultures) were the result of such pressures. He says,

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[11] It should once again be emphasized that this whole argument is based on analogy and the treatment of the American educational enterprise as if it were a society or culture. All writers on economic growth and development treat education as one of the very necessary conditions for general economic growth. Rostow includes education in his social overhead capital. Myrdal gives education the paramount role in development (46). Recent discussions have related education and economic growth in the United States (see (39) and (10)). However, no one has yet apparently realized that education itself can be subject to a secondary take-off--in Rostow's terms. This, in turn, and here the analogy ceases and straight line reasoning replaces it, is made possible by the fact that the entire American culture has reached the age of high mass-consumption, or has gone beyond consumption (Rostow), or has become the affluent society (Galbraith).

> The more general case in modern history, however, saw the stage of preconditions arise not endogenously but from some external intrusion by more advanced society and began or hastened its undoing; but they also set in motion ideas and sentiments which initiated the process by which a modern alternative to the traditional society was constructed out of the old culture. (56: 6)

13. Another idea which easily relates to the argument for the take-off condition is that Rostow indicates that "the beginning of the take-off can usually be traced to a particular sharp stimulus . . . It may come about through a technological innovation . . ." (56:36). American education has been subjected to three such innovations in the last decade--television, language laboratories (and the system of language teaching using them) and teaching machines and programed learning. Of these three, without question the sharpest stimulus has come from the development of programed instruction and the several categories of teaching machines which go with it.[12, 12a] Dael Woelfle has said that, "it (programed learning) is the first major technological innovation in education since the development of printing." (73)

Whether such extravagance is justified remains to be tested by subsequent events. There is no question, however, that the teaching machines--programed learning innovation has attracted the greatest public and professional interest of any educational innovation in recent--perhaps in all--history. The grateful Josiah Bumstead who, in 1841, said of the inventor of the blackboard, "The inventor or introducer of the blackboard system deserves to be ranked among the best contributors to learning and science, if not among the greatest benefactors of mankind," (2:23) was a voice crying in the darkness. Today, B.F. Skinner, teaching machines and programed instruction have caught the attention and interest of the public to the extent that stories and articles fill the mass media.[13] The teaching machines--programed learning development may well fill the Rostow requirement of a sharp stimulus provided by a technological innovation.

14. Back of the teaching machines--programed learning development stand a host of other technological developments not so well-known to the public or the profession.

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[12] See, for example, Finn, James D. and Perrin, Donald G. Teaching Machines and Programed Learning, 1962: A Survey of the Industry. Occasional Paper No. 3, January 1962.

[12a] Campion does not concur. He feels that television meets the requirements as to effect, acceptance, publicity, etc., much better than programed instruction.

[13] See, for example, George Leonard's excellent article in Look (June 5, 1962, pp. 58-70).

These include 8 mm sound film, cartridge loading projectors, fantastic uses of the computer in teaching and also studying the learning process, new systems of recording and distributing information, and an increasing build-up in research and development in learning and teaching. The stimulus having been applied, it can be argued that the way has been paved for a swift take-off which will include these new developments.[14]

15. It is apparent, however, throughout all of this discussion, that the preconditions for take-off are crucial. The build-up of social overhead capital and of a technological state of mind as well as arrangements which will permit change are absolutely necessary before take-off is possible. The sharp stimulus of a technological innovation or the linkage with neighboring cultures will not start the take-off unless the pressured culture is ready.

16. In the pages that follow we are presenting data that show the growth of teaching tools--principally audio-visual equipment--within American public education during the thirty year period, 1930-1960. This growth story represents, among other things, the introduction of a fundamental machine technology into the American school system. This equipment is the absolutely necessary social overhead capital required in the preconditions for take-off. The period chosen is, in itself, important. Prior to 1930, there was little in the form of communication equipment available to education. The growth patterns of acquisition then take on additional significance, as they reflect the general communication revolution as it entered education. The main point, however, is that we view the build-up of audio-visual equipment and materials in education as one of the principal preconditions for a technological revolution in education--for take-off in the Rostow sense.

The level this growth has attained and the speed and pattern of attainment are, we think, the best indicators of the future. Judgment has to be applied to the data in order to estimate whether or not the take-off point has been reached. It is clear, however, that, for example, the psychological preparation--the expectation of and aspiration for technological solutions to educational problems--cannot exist until a technological milieu exists to create this preparation. The extent to which audio-visual equipment is available to the working school teacher is a valid test of the strength of the milieu. If, for example, teaching machines or the electronic learning laboratory take the educational system by storm, it may be due more to the widespread availability of the 16 mm sound motion picture projector than all of the theories and research of experimental psychologists, the efforts of industry or the thousands of words and pictures appearing in the mass media. It is now time to look at the data.

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[14] There are still questionable elements in all of this. The economic problem, for example, is by no means solved. However, its status can be partially judged by the evidence reported in this study.

SECTION II

THE DEMOGRAPHY OF PUBLIC EDUCATION AS A BACKGROUND FOR TECHNOLOGICAL GROWTH

In the first section of this paper, a theoretical structure was set forth which held that the educational sector of the American economy was analogous to a primitive culture set among advanced cultures and that, due to several factors, this traditional educational folk culture was in transition. The data presented in this study concerning the "tooling up" of the educational sector is considered as an account of the development of "social overhead capital" and a move toward technological take-off.

Students of economic growth emphasize that a relation exists at all times between the possible capital (tools, in a sense) that can be accumulated and the demands of a growing population. In the case of the population of a country, these demands are for food, clothing and shelter. In the case of the educational folk culture, a growing population has created great demands for housing (schools) and personnel (teachers). Secondary demands, such as those for materials, equipment and technical services, have had, until recently, to wait--even though the materials, equipment and services would immeasurably improve the process and solve some of the housing-personnel problems.

Ward treats this problem extensively in a discussion of the economics of development of an underdeveloped culture. She says,

> The whole of our modern economy depends upon saving,[15] upon not consuming. But if year after year the population goes on increasing, the number of new mouths coming in to consume can quickly eat up the fresh savings which should have been available for transformation of the economy. (70:90)

And, a little later in her discussion, she points to the difficulties faced by traditional cultures attempting to transform themselves into technological cultures,

> The means of ending the disproportion between people and resources is to apply capital massively to the resources. The difficulty is to secure this massive saving when rising population forces up the levels of consumption. (70:91)

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[15] For investment in technological capital.

It takes little imagination to find in these statements the key to the dilemma of developing social overhead capital for American education. Lost bond issues and strained rates of property taxation are signs of the great difficulties of supplying the educational system with even a minimum subsistence.[16] The social overhead capital--the tools and materials of a technological culture--have had to be squeezed, very reluctantly, out of the minimum capital fund. The main demands on the fund are essentially from two sources--a rising population to educate and the necessity for longer periods of education to enable each individual and American society as a whole to cope with the increasing technological complications brought on by the technologically sophisticated sectors--industry, business, the military, and the scientific.[17]

To sum, American education has had to try to develop itself into a more technologically sophisticated culture while, at the same time, use its limited funds for simple survival. It is only very recently that this bootstrap operation has been aided somewhat by small infusions of Federal and foundation funds. To understand how far this operation has progressed, a small amount of data regarding educational growth in general will be presented in this section. The literature, of course, is filled with much more detail and we will present here but a few sample demographic statistics as a background against which to present the statistics on such technological capital as the American educational system has been able to accumulate. Any interested reader with access to a library can investigate this problem in great detail.

Schools and School Districts

The general growth patterns of and changes in American society are reflected in changes in the public schools. One-teacher schools and the "little red schoolhouse" which once symbolized American education have now given way to urban and suburban school systems and consolidated rural schools. This is illustrated by Figure 1, which shows the decrease in number of school districts and one-teacher schools against the increase in average number of pupils per school for the years 1930 to 1960. Note that the number of school districts decreases most rapidly after World War II, and also that there is an almost

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[16] For excellent discussions of the problems of educational finance, see (10), (39) and (62).

[17] The irony here should be apparent.

GROWTH OF SCHOOLS AND DISTRICTS: 1930 - 1960

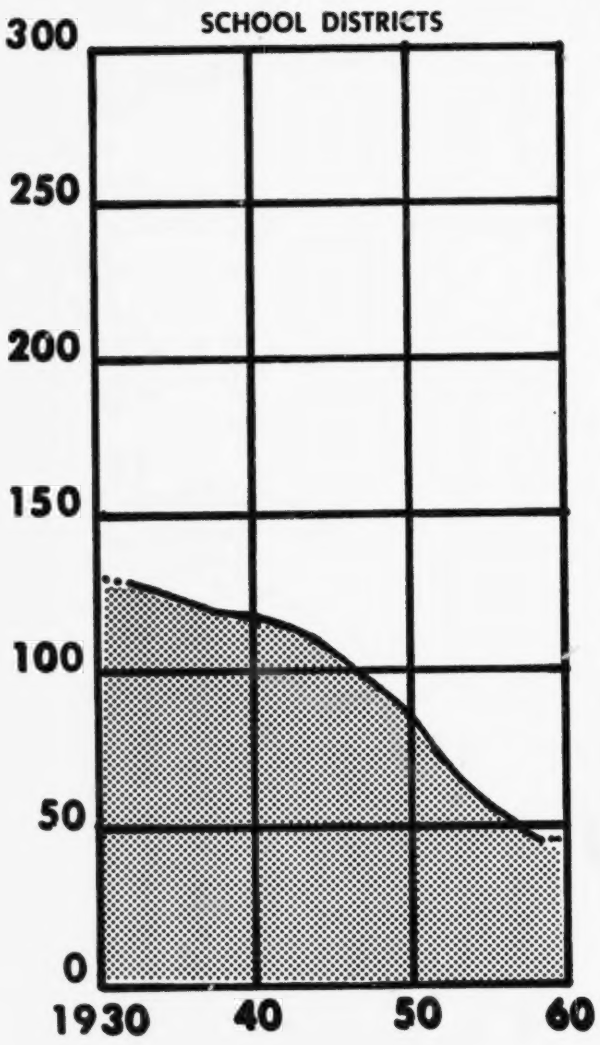
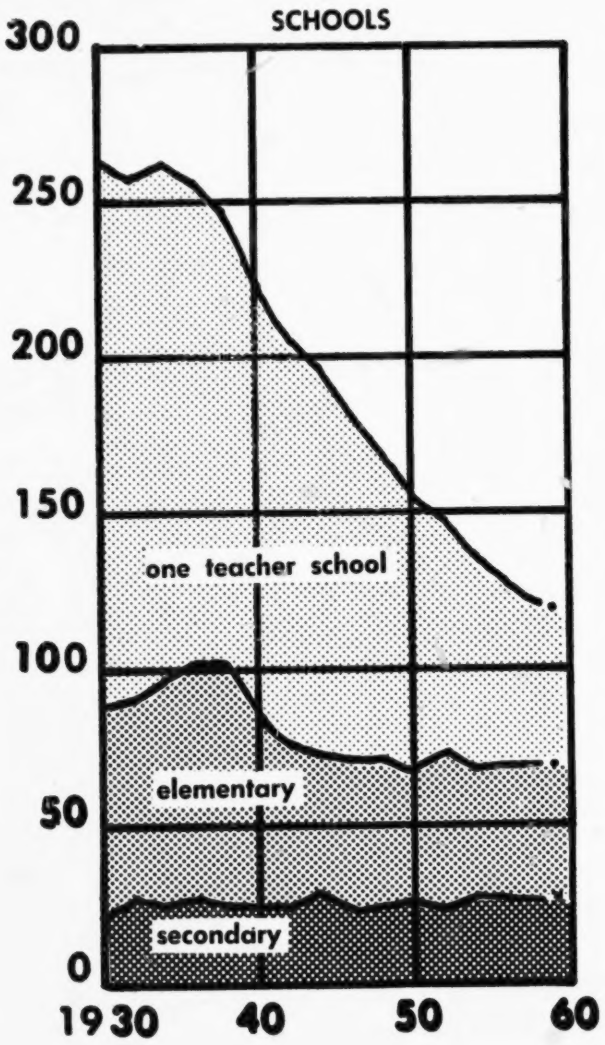
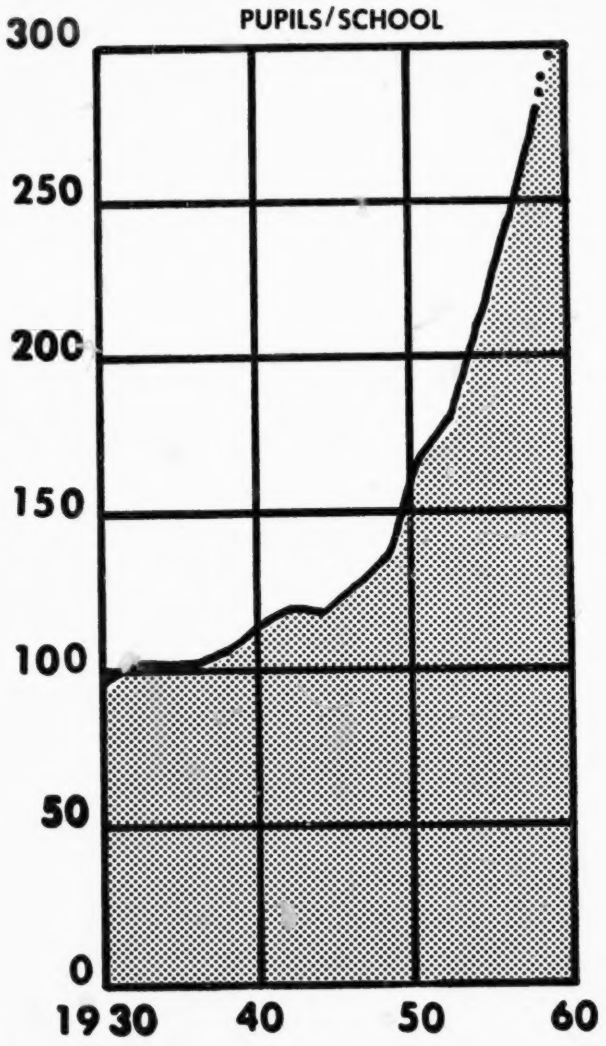


Fig. 1. Number of Public School Districts (in thousands) 1930 - 1960



Number of Public Schools (in thousands) 1930 - 1960



Number of Pupils Per School (average) 1930 - 1960 explosive increase in the number of students per school in this period--with no significant change in the number of elementary or secondary schools.

Students and Teachers

Not only have the number of students and teachers increased greatly over the last few decades, but, particularly at the secondary level, students have remained in school longer. This is spectacularly illustrated by the number of seventeen year olds graduating from high school, which has increased from 2.1 per cent in 1870 to nearly 67 per cent in 1960 (Figure 2). The number of college graduates has increased tenfold in the same period as compared with the population over 20 years old.

Figure 3 shows the increase in number of teachers compared to the increase in number of students. Both graphs are similar in form, but the gain in teachers has been slightly greater, so that the pupil/teacher ratio has decreased from 34.1 to 26.1 between 1870 and 1960. Both graphs show a relatively constant increase, with a leveling off beginning in the late 20's and a dip downward during the war years. The explosive increase in student population at the end of World War II is accompanied by a sharp increase in the number of teachers, so that the pupil/teacher ratio continues to improve. Figure 4 shows the collective change in pupil/teacher ratio for public elementary and secondary schools.

Superficially, it would appear that the educational culture is catching up to and passing its rate of population increase and that the conditions of developing technological capital have been reached. However, the decline in the pupil/teacher ratio tells only part of the story. The pupil/teacher ratio would be a decisive measure only if all other conditions remained the same. And they have not. Educational growth also has to be considered in terms of the length of the school year and the average attendance of pupils. If these remained stationary during the decline of the pupil/teacher ratio, then the workload of the teacher would be decreased and the number of individual student contacts increased. Both of these factors would improve the quality of education and, at the same time, would increase its efficiency.

In the eighty years covered by statistics (between 1870 and 1960), the school year has increased in length from about 130 to approximately 180 days, an increase of nearly 40 per cent. In the same period the average attendance per enrolled pupil doubled from 78 to 158

HIGH SCHOOL GRADUATES: 1870 - 1960

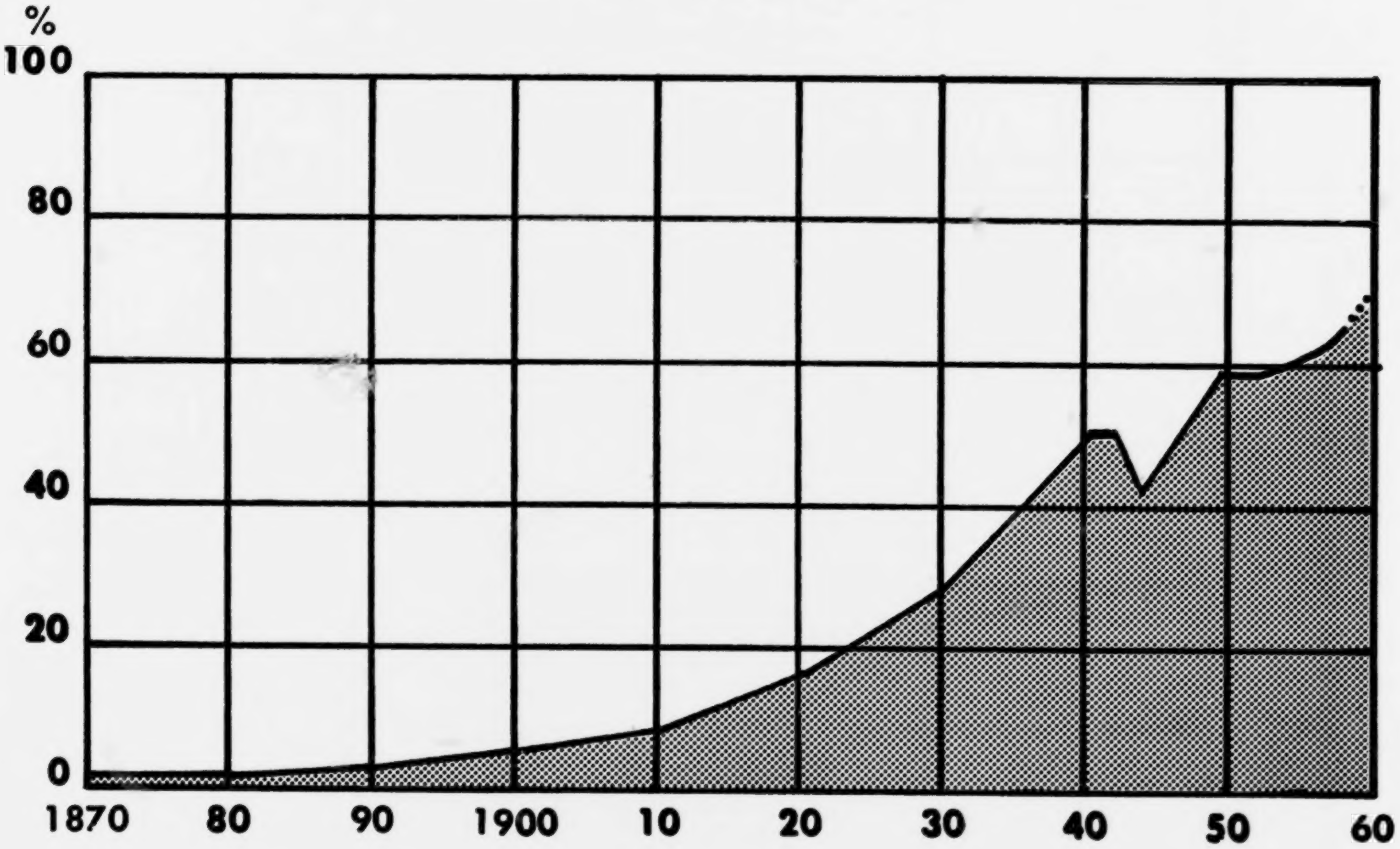


Fig. 2. Annual high school graduates expressed as a percentage of the total number of persons 17 years old.

GROWTH PATTERNS, TEACHERS AND PUPILS: 1870 - 1960

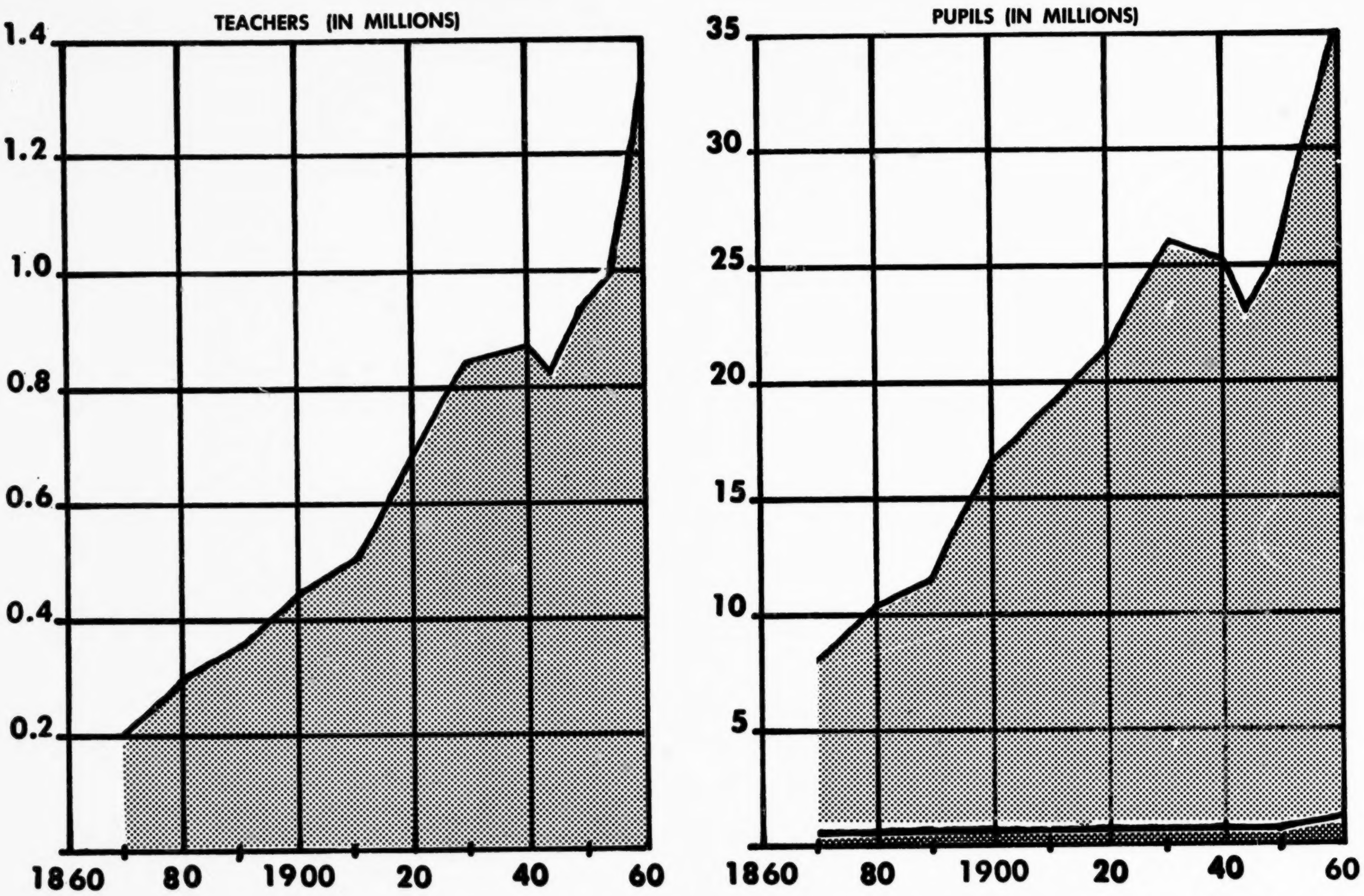


Fig. 3. Comparison of the growth in number of teachers in the public schools (graph on left) with the number of students. (The number of teachers compared to students is the dark shaded area at the bottom)

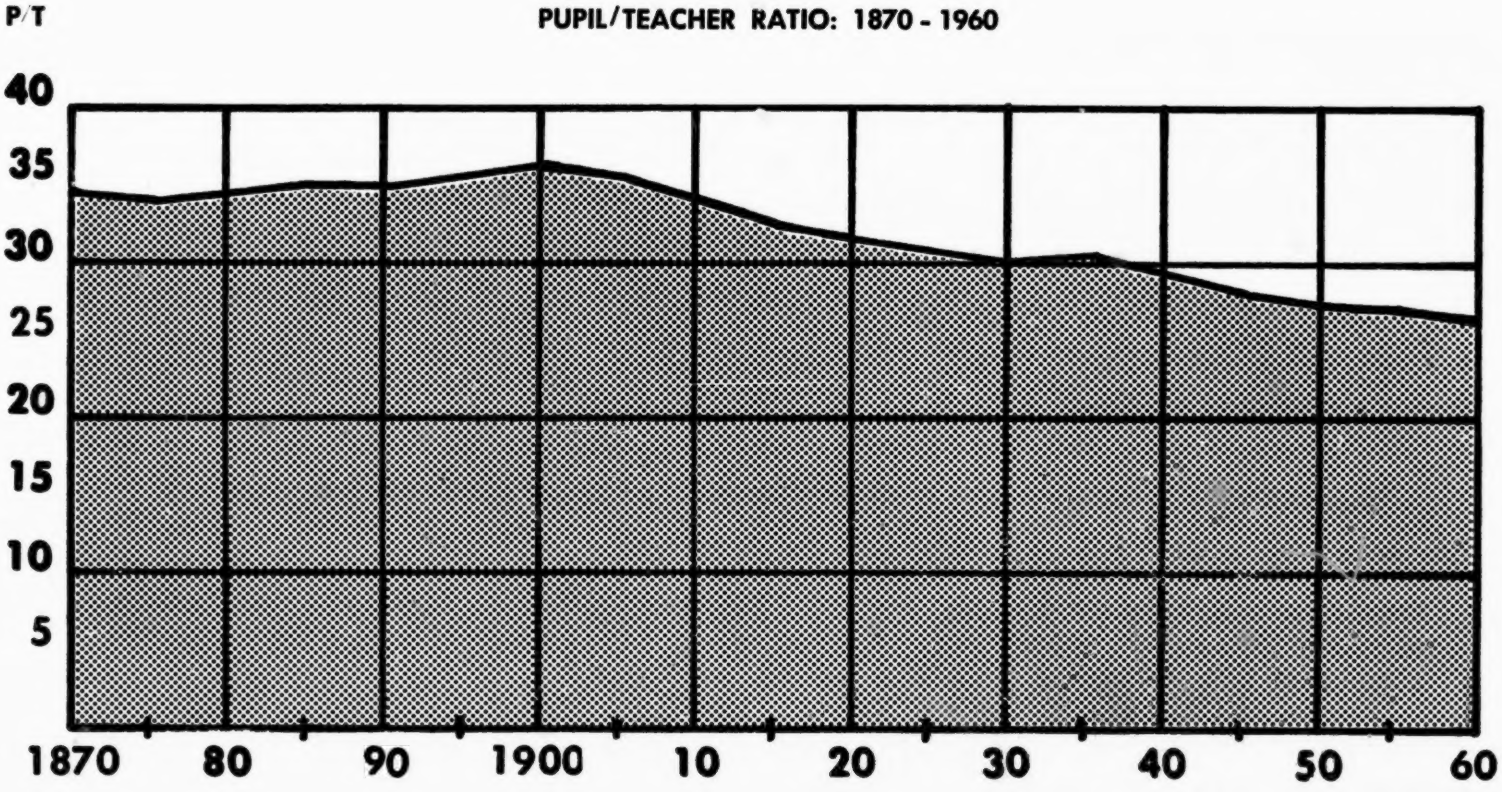


Fig. 4. Pupil teacher ratio for the public schools, 1870 - 1960

days; in other words, the average student attended about 60 per cent of the possible school days in 1870, rising to about 90 per cent in 1960. Figure 5 plots the increase in average attendance against the total number of days in the school year. The basic statistics for Figures 1 - 5 are to be found in Tables I and II of Appendix A.

Analysis

These facts show the problem of attempting to maintain even the same quality of system against the sweep of population change on the one hand and social change on the other. When the data are subjected to analysis, this becomes increasingly clear. The average attendance per student has increased by a factor of 2.0 over eighty years, while the median number of years at school has increased by a factor of about 1.6. Therefore, the amount of education per student (in total number of days at school) has tripled (2.0 x 1.6 = 3.2), and the total increase and output of the public school system is derived by multiplying this figure by a factor of 2.3, the increase in number of students. This calculation (3.2 x 2.3 = 7.4), then shows a sevenfold increase in the total educational product.

Our analysis is verified by a statement of the President's Council of Economic Advisers. In the 1962 report to the President, they said,

> Rough estimates, which take into account differences in the length of the school year and in school attendance, suggest that the stock of equivalent school years in the labor force rose more than sixfold between 1900 and 1957. (12:117)

In addition to the great strain put upon the school system and the evidence of a great effort to meet that strain, the analysis clearly shows the effect on the pupil/teacher ratio.

Because of the increase in average attendance, the improvement in pupil/teacher ratio has not made the class groups significantly smaller, although the variability of numbers is considerably reduced. Taking 70 per cent of the average of 36 students per teacher in 1900 would give a class group of about 25 students, (with a possibility of up to 11 more), while 90 percent of the 26 students per teacher in 1960 would give an average class size of 23. This is not a significant reduction in the pupil/teacher ratio.

In fact, compared to the improvements in other sectors of our economy, these data, taken as a whole, (1) represent a great effort on the part of the American people to maintain the status quo of 1870 in terms of educational manpower, (2) show the difficulty of "applying capital massively to resources" in order to end "the disproportion between people and resources" in education, and (3) give added significance to whatever technological capital has been squeezed out of the system which would make it possible for an educational take-off.

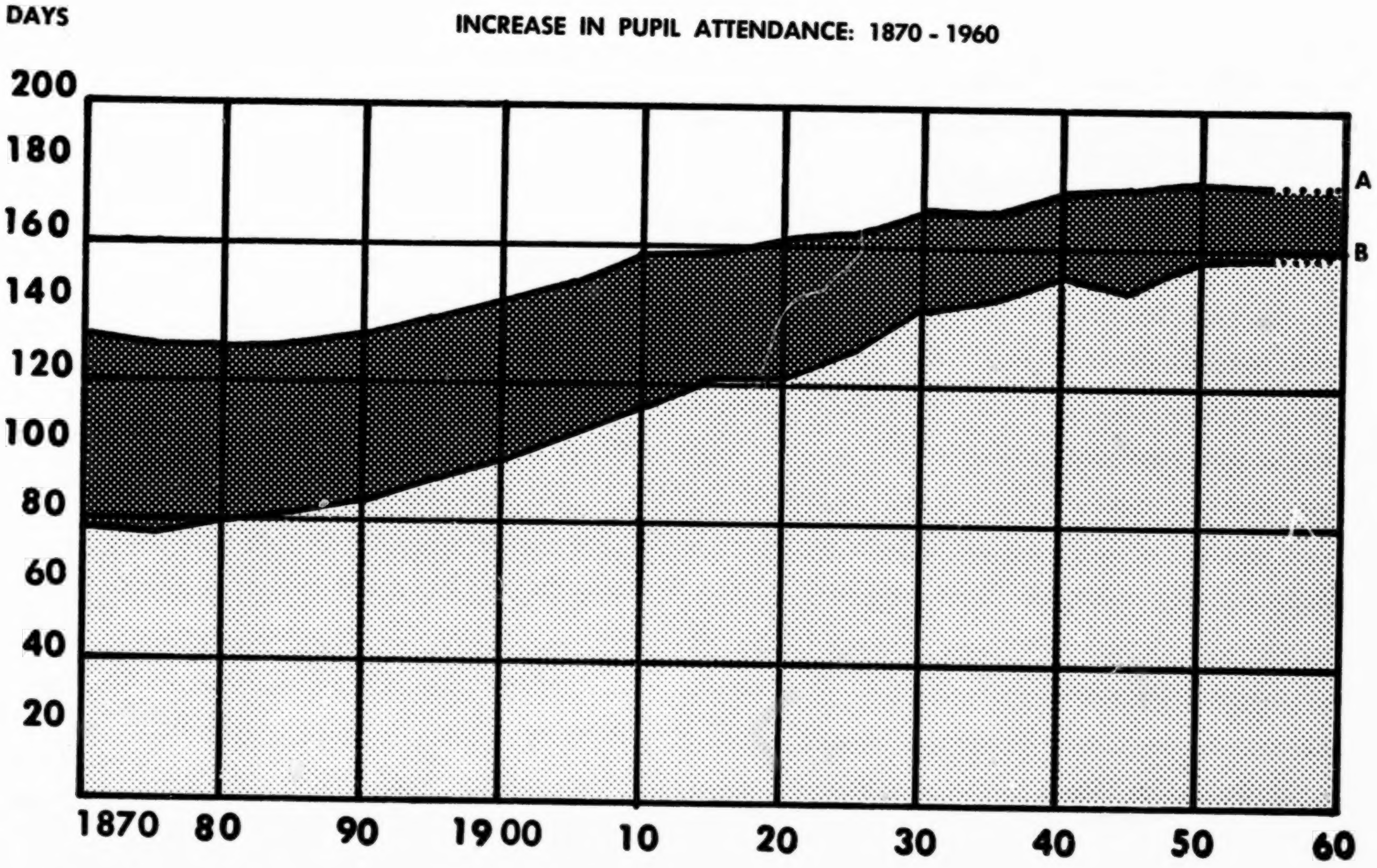


Fig. 5. Comparing the length of the school year (A) with the average number of days attendance per pupil (B), for the years 1870 to 1960.

The manpower situation described above provides ammunition for many of the advocates of a technological revolution in education. Predictions of future demographic changes in education are, of course, all in the direction of more students at all levels and many students in school and college for yet longer periods of time. Suggestions as to how to achieve "more learning in less time;" proposals for reorganization and relocation of manpower such as those suggested by Lloyd Trump (64); the use of television and massed films as partial solutions to the coming teacher shortage as advocated by the Ford Foundation; the advocacy of programed instruction as an answer to teaching the individual in the mass situation by the Center for Programed Instruction are all examples of responses, at least in part, to the manpower-production problem in education.

However, these and other plans simply do not supply all of the answers (and it should not be forgotten that they are also proposed for other, well-founded educational reasons). They are proposals for a technological revolution in education that must wait upon the build-up of social overhead capital in the form of enough tools so that the educational culture is ready and full of expectation of and aspiration for technological growth. And this build-up must, in turn, be achieved while most of education's capital goes into subsistence--unless a massive infusion of funds from outside sources improves the situation. Television will not succeed without television sets; massed films must have projectors; large group language instruction requires electronic learning laboratories; even replacing current textbooks with such simple devices as programed books presents a difficult challenge. In the pages that follow, we present data as to the growth of tooling for instruction. It should be continually thought of in connection with the overall growth of the educational sector.[18, 19]

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[18] We are well aware of the fact that there are critics of American education who maintain the economic problem doesn't exist and all that is necessary for a quality education is some kind of a return to whatever "fundamentals" the particular group has in mind, such as a total phonics program in reading. While we are suspicious of the motivation of many of these critics and feel that an objective blind man could see the economic problem, we are not maintaining that the only elements in a quality educational program are economic. However, until the economic problems are solved, we fail to see how other quality elements may be added. We assume, for example, that even such cantankerous critics as the Council for Basic Education would agree that some instruction concerning atomic energy would have some value. To do this properly without the modern tools of instruction for the great mass of American students, including the brightest, would be well-nigh impossible.

[19] Cognizance should also be taken of increasing reports of mounting class size in the large cities and the failure of bond and tax issues designed to meet minimum subsistence requirements.

SECTION III

METHODOLOGY

Purpose of the Study

This study attempts to plot the quantitative aspects of the growth of audio-visual equipment in the public schools of the United States, principally over the period, 1930-1960. Items of audio-visual equipment, such as motion picture projectors, tape recorders, etc., are considered one category of indicators of the growth of instructional technology in American education.[20] Since the audio-visual field is another example of the razor-razor blades problem, observers have long noted that the amount of equipment available and the use of materials are highly inter-related in every case from films and projectors to records and record players.[21] Hence, the equipment supply, as an indicator, is a measure of the capability for certain kinds of instruction. It is also, of course, a measure of the level of technological sophistication of the educational enterprise as noted in the previous section.

Methodology

The types of equipment selected for the analysis of growth patterns were those items of audio-visual equipment commonly used in schools and colleges for instruction. Over the thirty-year period considered, different items of equipment have been inserted into the educational system at different times as the communication revolution has developed. The equipment selected was as follows:

1. Motion Picture Projection Equipment
    a. 16 mm sound motion picture projectors

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[20] The Technological Development Project is publishing several other studies of technological growth. These include the R & D study mentioned earlier, a study similar to this one on audio-visual materials of instruction, and a special case study of the development of closed-circuit television.

[21] See, for example, the evidence presented by Hoban on the wartime experience with Signal Corps films (36:55).

2. Still Picture Projection Equipment
    - a. Slide/filmstrip projectors
    - b. Opaque projectors
    - c. Overhead transparency projectors
3. Sound Equipment
    - a. Record players
    - b. Tape recorders
    - c. Language laboratories (electronic learning laboratories)
    - d. Central sound systems (which may also include radios)
4. Broadcast Reception Equipment
    - a. Radio receivers
    - b. Television receivers

It will be noted that this list includes only those items useful for the transmission, reception and, in the case of electronic recorders, manipulation of messages. These items are essentially classroom devices and the list does not include production equipment such as cameras, studio recorders, television cameras, etc. Further, due to the special attention paid to closed-circuit television in another study, no items related to closed-circuit television are included except where television receivers have been counted.

The development of the growth curves was accomplished by the following procedures:

1. Analysis of Published Studies

All known surveys and reports, industrial and educational, that have been published were located and analyzed. These ranged from carefully constructed educational surveys such as those conducted by the Research Division of the National Education Association in 1946 and 1954 through reports of individual industrial associations to such overall studies as the United States Census of Manufactures. Some studies covered a range of equipment, others only one item. The studies were done at different times on different samples with different purposes. The general-coverage published studies used are listed in Table III. Others will be referred to in the text.

2. Analysis of Unpublished Material

A great deal of unpublished material was similarly examined. This included, for example, material in the National Archives pertaining to War Production Board figures on projector allocations during World War II, files in the office of School Management Magazine, etc. The generally relevant unpublished material is also listed in Table III.[22]

3. Confidential Survey of the Audio-Visual Industry

Because known published material did not contain sufficient data to accomplish our purposes, Campion and Finn conducted a confidential survey of the audio-visual industry designed to obtain an historical account of sales figures for units of equipment from 1930-1960. The survey was conducted as follows:

a. The National Audio-Visual Association, the trade organization of the audio-visual industry, was contacted. With the cooperation of Mr. Don White, Executive Vice-President, a list of companies was drawn up representing the major producers for each item of equipment.

b. A survey instrument was designed, keeping in mind that the information requested is generally considered to be in the category of trade secrets. Hence, it was made as general as possible. A copy of the survey form appears as Appendix B.

c. A letter was sent to each company explaining the nature of the study, outlining the security measures which were designed to protect the trade information, and enclosing a copy of the survey form. Each company was asked to indicate whether or not they would cooperate.

d. The security measures were as follows:

(1) Each company was given a code number

(2) The code number and the company name was kept in the Washington office of the Project.

(3) The company was asked to return the completed form which carried code number only to a firm of Certified Public Accountants, Barro and Morrisse of Arcadia, California.

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[22] A complete bibliography covering all aspects of this report can be found at the end of this study.

TABLE III[23]

STUDIES AND REPORTS OF A GENERAL NATURE USED IN THE PREPARATION OF THE GROWTH CURVES

Date	Investigator	Biblio. Ref.	Pub.	Unpub.	Subject
1936	Cline M. Koon and Allen W. Noble	43	x		National survey of audio-visual equipment and materials for the USOE.
1940	Herbert E. Jensen	40, 41		x	Survey of school experience with motion picture projection equipment for the Committee on Scientific Aids to Learning.
1942	Nathan D. Golden	31, 32	x		Survey of motion picture equipment in elementary, high schools and colleges.
1946	Research Division, National Education Association	4	x		Survey of audio-visual programs in city school systems.
1947	Bureau of the Census U.S. Department of Commerce	67	x		Census of Manufactures.
1948	Committee of Seven Publishers	55	x		Study of the potential market for educational films.
1949	Seerley Reid	54	x		Survey of motion picture projectors in the high schools.
1950	James A. Moses	45	x		Report on 16 mm projection equipment in the army.

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[23] Other, more specialized studies used are reported in the pertinent sections.

Table III (Continued)

Date	Investigator	Biblio. Ref.	Pub.	Unpub.	Subject
1954	Research Division, National Education Association	6	x		Survey of audio-visual education in urban school districts.
1957	John Flory	21	x		First report of a series on the economic impact of the audio-visual field.
1958	Bureau of the Census, U.S. Department of Commerce	68	x		Census of Manufactures.
1959	John Flory and Thomas W. Hope	22	x		Scope and nature of non-theatrical films in the United States.
1959	K. C. Rugg	57	x		Case studies of audio-visual budgets in selected school districts.
1960	John Flory and Thomas W. Hope	23	x		Continuation of the study of the non-theatrical film.
1960	Augustus Wolfman	74	x		An annual statistical report on the photographic industry in the United States.
1961	John Flory and Thomas W. Hope	24	x		Continuation of the study of the non-theatrical film.
1961	Eleanor P. Godfrey	30		x	A national sampling survey of audio-visual media in the public schools for the U.S. Office of Education.
1961	Augustus Wolfman	75	x		Annual statistical report on the photographic industry in the United States.

Table III (Continued)

Date	Investigator	Biblio. Ref.	Pub.	Unpub.	Subject
1962	Paul Andereck	5	x		Inventory of audio-visual equipment and materials in St. Louis County (Mo.) Public Schools.
1962	Thomas W. Hope	25		x	Continuation of the study of the non-theatrical film.

(4) Barro and Morrisse were instructed to supply to the Los Angeles office of the Project only the totals obtained from all of the companies in tabular and graphic form year by year.

(5) For follow-up and clarification purposes, Barro and Morrisse would furnish the code number to the Los Angeles office which in turn would advise the Washington office. The Washington office would then, in turn, contact the company.

e. The majority of the companies contacted agreed to participate and the survey was carried out. Table IV indicates the number of contacted and participating companies. While these companies do not represent all of the production of the industry, they represent by far the largest percentage and in some cases, all but a few per cent. In a few instances a key company refused to cooperate. This will be noted. The development of this information represented a great deal of work on the part of the cooperating companies; several difficulties were encountered as, for example, when the company had changed hands one or more times during the period under study. The results of this survey were by no means perfect, but they do represent the best information of this kind ever put together.

4. Coordination with the Godfrey study

Dr. Eleanor P. Godfrey is conducting a nation-wide survey of the current use of audio-visual media in the public schools of the United States as principal investigator for the Bureau of Social Science Research, Inc. under a contract with the United States Office of Education. Dr. Godfrey has completed the phase of her study dealing with the equipment in the U.S. public schools as of the spring of 1961. Close contact was maintained with the Bureau of Social Science Research during the development of

TABLE IV

RESPONSES TO CONFIDENTIAL SURVEY

Category[24]	No. Invited	No. Cooperating
16mm Sound Motion Picture Projectors	5	5
Filmstrip Projectors	6	6
Slide Projectors	5	5
Sound Slidefilm Projectors	4	2
Opaque Projectors[25]	4	2
Overhead Projectors[25]	4	2
Record Players	4	2
Tape Recorders - Repetitive	1	1
Language Laboratories	17	13
Television Receivers	5	3

this study. Since Dr. Godfrey surveyed almost 3,000 school districts throughout the United States on a careful sampling basis, this study uses her figures as the final benchmark for the growth curves. Where there was contradiction between the Godfrey figures and other figures -- for example, those published by Flory and Hope -- and the difference could not be explained or resolved, the Godfrey figures were the ones used. Pertinent excerpts from the Godfrey study appear in Appendix C in Table VII.

5. Consultation with Knowledgeable Individuals

Due to the variety of the data, the fact that certain data were missing and that both estimation and interpretation had to be used to arrive at the growth curves which were developed, consultation and information was sought from a variety of knowledgeable individuals. The names of these individuals appear in Table V. It should be emphasized that these people are in no way responsible for the conclusions arrived at by the investigators, but we are very grateful for their assistance.

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[24] Tape recorders were eliminated due to the difficulty of getting an adequate sample.

[25] As will be seen from Table VI in Appendix C, on items of equipment where not enough industries agreed to cooperate, figures are not supplied. The only important omissions are in the overhead and opaque projector categories where one of the major producers refused to cooperate on the grounds that he would be supplying vital trade information to his competition.

6. The Process of Estimation

As can be seen from the foregoing account, the investigators were working with several groups or categories of similar, but not comparable data. The statistics derived from the published and unpublished reports were inconsistent with regard to population and method of sampling. Even the confidential survey and other confidential marketing information which was obtained was difficult to fit into one regular pattern.

Every effort was made, therefore, to develop a consistent set of data by compensating for the factors known to be operating at the time any set of measurements might have been made -- for example, World War II. In addition, the number of data sources permitted cross checking and the use of alternative approaches as a means of validation. Finally, opinions were sought from informed persons, some of whom had access to marketing information not directly available to the Project.

After compensating for historical circumstances, cross-checking and securing opinions on trial estimates, final estimates were made. For the most part, these were made independently by Campion and Perrin and, if there was a disagreement, further cross-checking and opinion-seeking took place until a consensus was reached. Details of estimating procedures will be presented under pertinent headings.

Limitations

The fundamental limitation of this study (other than the natural limitations of the investigators) is the nature of the data. There are gaps which cannot be filled; there are inconsistencies which have been difficult to resolve; there are extrapolations which are probably too daring or too conservative. However, we believe that, in general, the trends shown are fairly accurate. Additional hard data would make a difference on the curves from year to year, but not in the general trends. Any such excursion into the recovery of historical data and into the process of estimation suffers from limits of method. Recognizing this, we are prepared to be as explicit as we can and let the educational and industrial community be the judge.

TABLE V

INDIVIDUALS CONSULTED DURING THE STUDY

Name	Position
B. Edelman	Assistant Manager Government-Industry Relations Western Electric Company
Dale Eymann	Audio-Visual Department Los Angeles City Schools
John Flory	Advisor on Non-Theatrical Films Eastman Kodak Company
Robert Frick	Specialist General Electric Company
Robert C. Gerletti	Director, Audio-Visual Education Los Angeles County Schools
Nathan D. Golden	Business and Defense Service Administration U. S. Department of Commerce
Thomas W. Hope	Assistant Advisor on Non-Theatrical Films Eastman Kodak Company
Robert M. Hutchins	Chairman, Center for the Study of Democratic Institutions
Joseph C. Hutchinson	Specialist for Foreign Languages U.S. Office of Education
Joseph H. Kanner	Chief, Audio-Visual Applications Office Army Pictorial Division Office of the Chief Signal Officer U.S. Army
Edwin Kline	General Manager The Management Publishing Group
Robert Isenberg	Assistant Director Rural Education Service Division National Education Association
Robert Maher	Statistician Eastman Kodak Company

TABLE V (Continued)

Name	Position
Francis W. Noel	Director, SAVES Project University of Southern California
Seerley Reid	Assistant Director Educational Media Branch U.S. Office of Education
Malcolm Townsley	Vice-President Bell & Howell Company
Donald White	Executive Vice-President National Audio-Visual Association
Augustus Wolfman	Editor-in-Chief Modern Photography

SECTION IV

16 MM SOUND MOTION PICTURE PROJECTORS

Edison introduced his Kinetograph camera using 35mm film in 1889, and the Lumiere brothers produced the first practical projector in 1895. The instructional use of motion pictures was suggested before 1900, but because of the cost and difficulty of operating the equipment, little was done for a quarter of a century. Films were used in World War I to educate as well as entertain troops. The first experimental study of the educational film by Lashley and Watson resulted from this war time use (35). The introduction of non-inflammable 16mm film in 1923 and the necessary camera and projection equipment supplied the basic tools of the educational film maker.

The first 16mm sound projector was developed in 1930, and gradually the sound film came to be accepted, to some degree, as a first rate educational tool. Development was halted, for the most part, by World War II, but the successful military instructional film programs provided a great impetus to the instructional film program in the schools after the war. Buying leveled off somewhat in the early 50's due to competition from other audio-visual media and limited school budgets. Also, obsolescence began to take its toll.

Significance of the 16mm Sound Motion Picture Projector as an Indicator

The 16mm sound motion picture projector is, without question, the symbol of the audio-visual movement in American education. In some respects this has been unfortunate in that educational administrators and the general public, as well as a substantial element of professional audio-visual personnel, have thought of audio-visual communication solely in terms of the 16mm sound projector, neglecting both the theory of the wide range of materials and devices normally classified as "audio-visual,"[26] and the practicality of this range of devices and materials in educational communication.

Never-the-less, the 16mm sound projector did represent a technological breakthrough that lasted long after its introduction into education in the 1930's. The possibilities of the sound motion picture for teaching and learning were so intriguing that they have occupied the attention of research workers to the present day. The equipment for projection and the system of film distribution and use was complicated enough to be the first true test of the possibilities of a technology of instruction.

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[26] See, for example, a standard audio-visual text, such as Dale (13).

American education has had over thirty years of experience with the sound motion picture. This experience, with a few exceptions, such as the various forms of the lantern slide, is the longest the educational enterprise has had with a complex technological system related to instruction.[27] Further, because of the general interest in the phenomenon, we have more statistical information for this thirty year period than for any similar device or system. Hence, because the growth of the 16mm sound motion picture projector in education is probably the best single index of the development of the audio-visual movement and because we have the best statistics on this growth, this section will consider the story in some detail.

The Process of Estimation

The data used for developing the growth curve may be found as Tables VI to XII in Appendix C. In addition to the sources cited in Section III, certain unpublished figures (49), (71), (38) were used, and access was obtained to certain confidential marketing information through the courtesy of a manufacturer.

In developing the total growth pattern, the following factors were considered:

1. Total U.S. production statistics which were derived from Census figures, industry surveys, the Finn-Campion survey and confidential marketing information.
2. Exports, principally derived from Census figures.
3. Per cent of sales to educational institutions--the derivation of which is discussed below.
4. Per cent of sales to U.S. public schools which is similarly discussed.

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[27] In this sense, we do not include certain portions of the technology of printing and bookmaking. There is no question, for example, that the introduction of the new graded, word-count readers in the middle 20's was another kind of instructional technology. However, from the point of view of the school, the introduction of this system of reading instruction was not as technically complicated.

5. An obsolescence factor in years derived as indicated below.

6. The relative number of 16mm sound projectors in rural and city schools, and in elementary, high schools and colleges, and in public and private schools. These figures were developed by interpolation and extrapolation from several studies of equipment held by various segments of the educational system as indicated in Tables VII, VIII, XI, Appendix C.

7. Historical events which influenced changes such as:
    1. The availability of equipment and materials.
    2. Known expenditures as, for example, NDEA.
    3. Prevailing economic conditions (war, depression).
    4. Prices and marketing policies.

Figure 6 shows a plot of the first five factors. The production figures after 1949 reflect the rise and fall of sales, while up until 1949 supply could not catch up with demand. Trends for 1955-60 are based on statistics from the Finn-Campion survey, which supplied total sales figures as well as sales to education (colleges and public and private schools). The sales figures for 1946-54 were adjusted to match known trends (rapid growth at the end of the war, then leveling off) and to adjust the final total in the public schools to that measured by Godfrey (30). Reference should be made to Table XII in Appendix C for this and the following discussion.

The ten year obsolescence factor was adopted after consultation with dealers and audio-visual centers in the large city systems, and confirmed through the case studies of Rugg (57). It would seem that a number of the larger city school systems trade their projectors after only five years of service, but longer usage and purchase of some second-hand projectors by the smaller school systems would maintain the average at about ten years.

The percentage of sales to the public schools is difficult to assess. Historical statistics show that public schools receive approximately 66 per cent of the total monies spent on education, and have about 75 per cent of the enrolled number of students (private schools approximately 15 per cent, colleges 10 per cent) (65). Seventy per cent was finally adopted, as midway between the percentages of money spent and the number of enrolled

SALES PATTERNS: 16MM SOUND MOTION PICTURE PROJECTORS: 1936 - 1962

(in thousands)

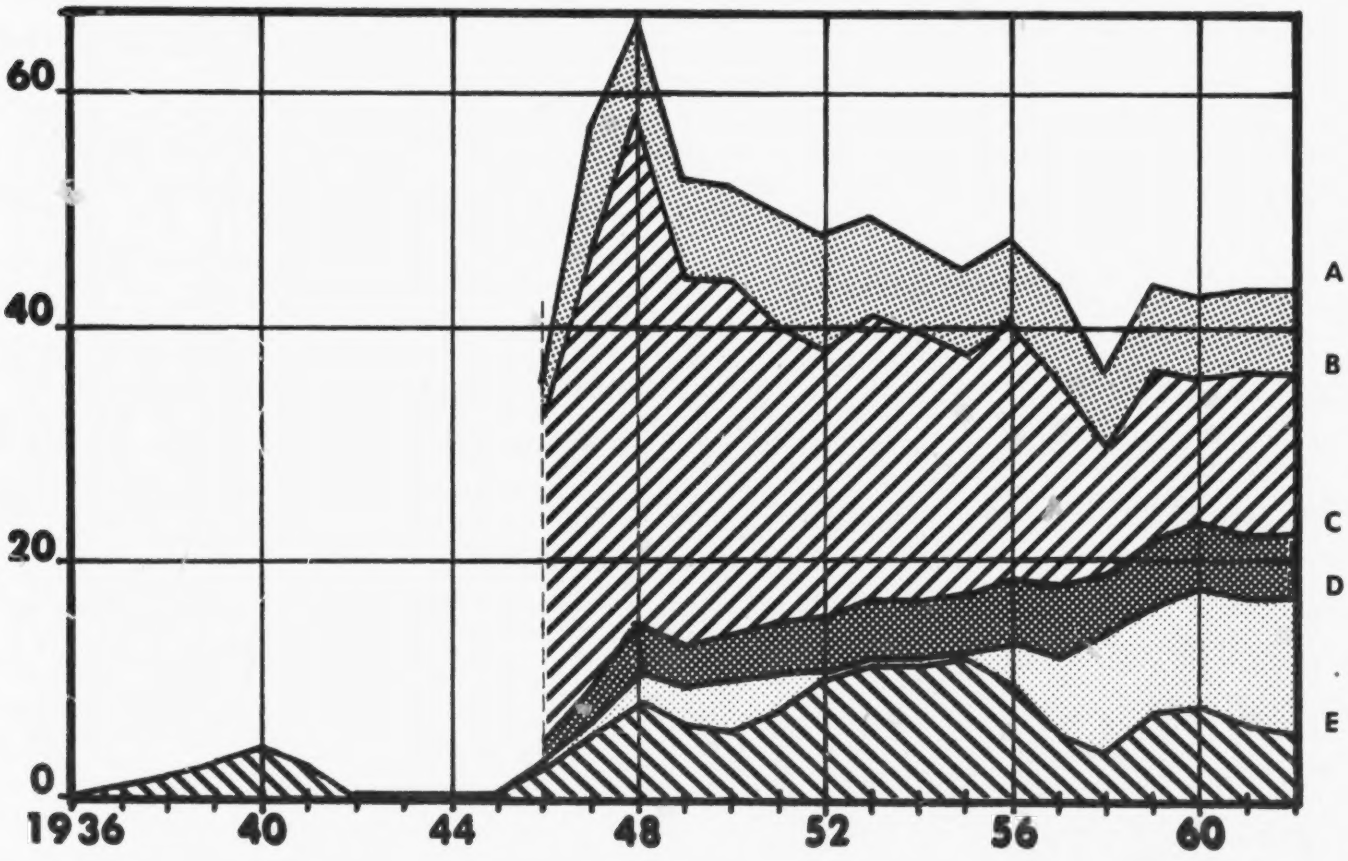

Fig. 6. Annual sales of 16mm sound motion picture projectors in the U.S. compared to the yearly increase in the public schools.
A. Annual production.
B. Annual sales in the United States (excluding exports).
C. Annual sales to all schools and colleges.
D. Annual purchases by the public schools.
E. Annual increase in the public schools after replacing worn and obsolete equipment.

students. After the passage of the National Defense Education Act, this is raised to 75 per cent so that the major part of the increase shown in the figures goes to the public schools. The percentage to U.S. education as a whole is known only for 1954, where Census figures on the left of Table XII can be equated to total in the public schools on the right. For the years 1947-53, this series of percentages acts as a balancing factor, linking information on either side of the graph.

The breakdown of educational sales is also shown in Figure 6. The bottom area represents the yearly increase in projectors in the public schools after replacing those which, for one reason or another, have become obsolete. After World War II, there was an intensive period of buying which reached its peak in 1948, dropped in 1949, and has subsequently shown only a gradual increase. As the pre-war projectors became obsolete, the increase over obsolescence decreased except for the years, 1952-55, where a very small number of projectors became obsolete due to lack of purchases during the war.

The challenge to American education presented by Sputnik in 1957, and the continuing growth of new schools and new classrooms during this period caused purchases to continue to increase, although obsolescence cut heavily into the total. In 1958, many schools withheld purchases in expectation of NDEA funds the following year. By coincidence, 1958 was the year when the greatest number of projectors were in need of replacement, so that the increase over replacements was very small indeed. Since NDEA, the number of new projectors purchased has increased about 25 per cent above the previous trend, but the number of additions over replacements is doing little more than keeping up with the rate of increase of student population or classrooms.[28]

Total Number of Projectors in the Public Schools

By adding together the yearly increase after replacing obsolete machines, the total number of sound motion picture projectors in the public schools can be assessed, and the growth pattern is depicted in Figure 7. The lack of purchases during the war period and the sharp leveling off between 1956 and 1958 are the most dominant features. Note also the slight leveling between 1948 and 1952 due to increasing obsolescence without increase in purchases, and the slight increase for 1952-55 due to the decrease in purchases during the war. It is also apparent that the rate of increase since NDEA is much slower than the growth of five or ten year earlier.

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[28] The statistics plotted on the graphs of Figures 6 and 7, based on Tables VI - XII in Appendix C, do not coincide entirely with the published figures of Flory and Hope (21), (22), (23), (24), (25). Since the Flory-Hope figures were pioneering estimates that did not have access to certain data obtained by the Technological Development Project, this is to be expected. Continuous contact has been maintained between Flory and Hope and the staff of the Project and revised estimates may be expected in the future in the continuing series of valuable reports published by these two gentlemen.

Plotting this same graph in terms of projectors per 100 teachers on paper with a vertical logarithmic scale enables the percentage increase year by year to be readily compared (see center graph, Figure 8). The more nearly vertical the line, the greater the percentage increase, and parallel lines have the same percentage increase. Except for the break during World War II, the growth curve follows an almost classical pattern.

Compare this growth pattern with that for the development of the telephone in the U.S. (see left-hand graph, Figure 8). The telephone was invented in 1876, and it was about 20 years before a steady increase in growth was established. Sales continued to increase for the next fifteen years, with some leveling off in the 20 year period to 1930. For the years 1930-40 sales were in proportion to the increase in population, representing a level area on the graph, after which new markets were established and the curve again rises steadily. The curve for 16mm sound projectors is similar, except that the time interval is about halved, and the war causes a break in the pattern.

In 1959, Finn hypothesized a general (or zeroeth order approximation) graph of the growth of instructional technology. (20) (see right-hand graph, Figure 8). The figures now show that the general shape of the curve, insofar as the 16mm sound projector is a useful indicator, is a reasonable approximation of actuality (first order approximation). The hypothesized leveling in the 50's and the spurt after Sputnik are, however, much too pronounced. Later evidence, for example, the growth of the language laboratory, will be applied to the same problem.

16mm SOUND MOTION PICTURE
PROJECTORS IN USE IN THE PUBLIC SCHOOLS: 1936 - 1962
(in thousands)

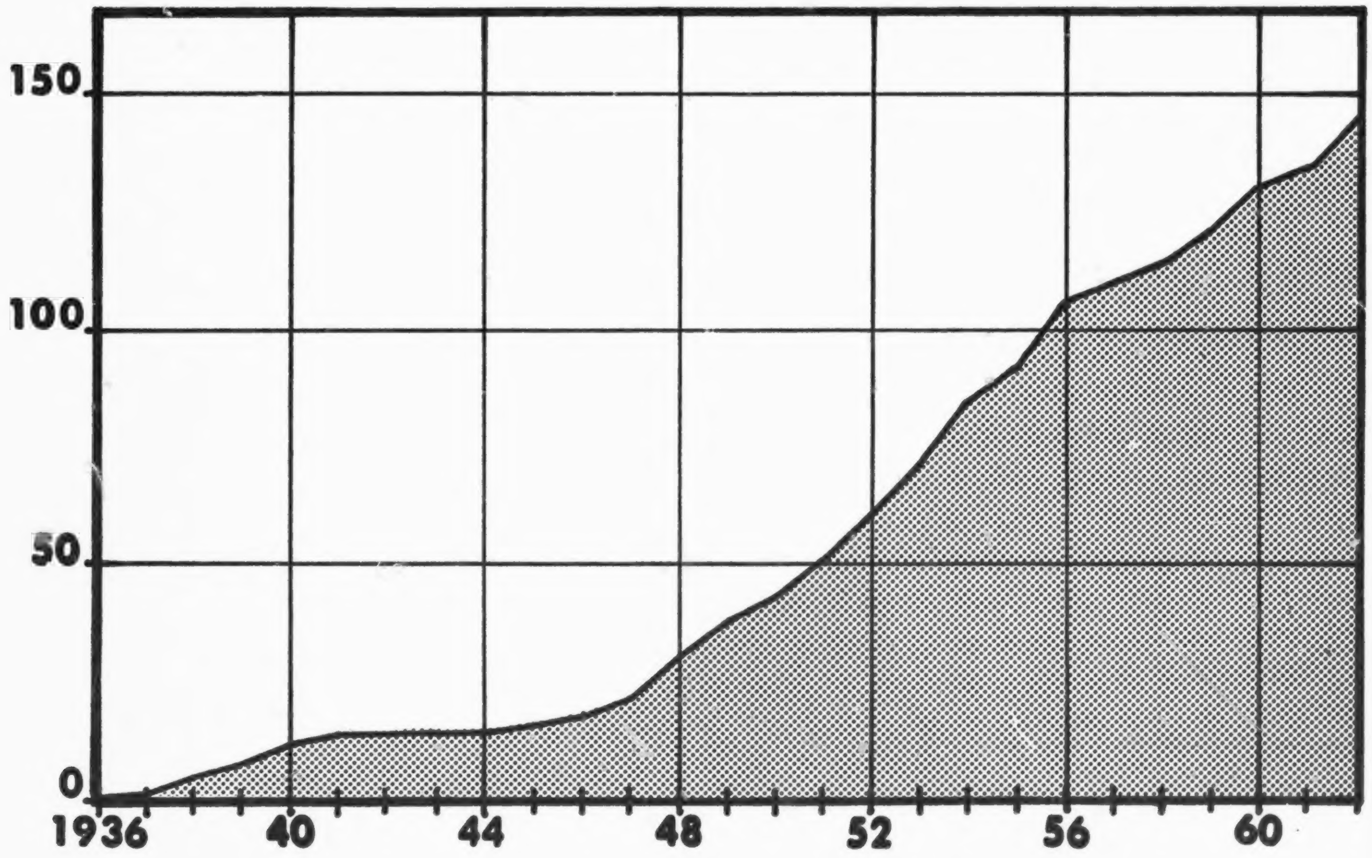
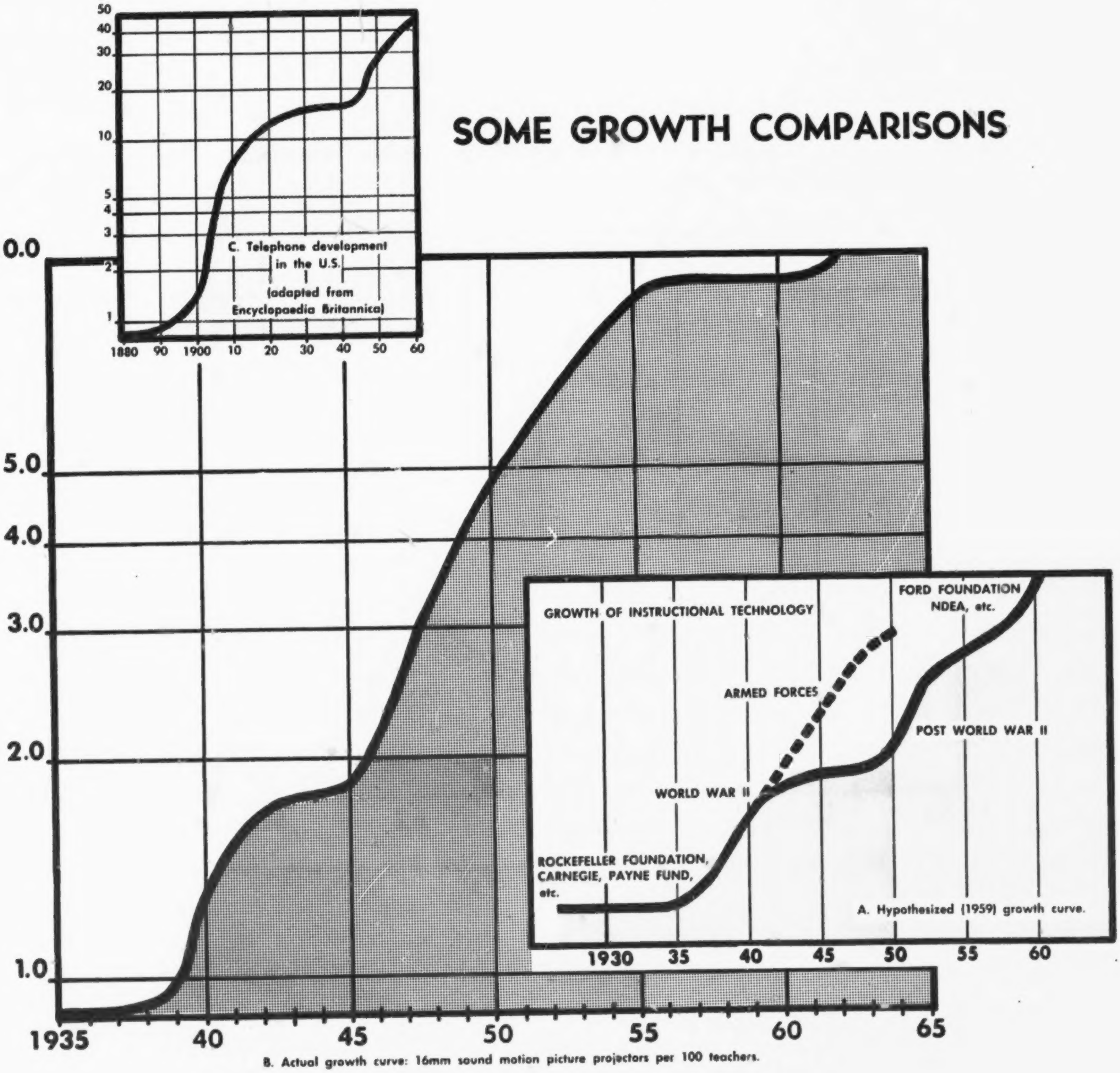


Fig. 7. Total number of 16mm sound motion picture projectors in use in the public schools, 1936 - 1962.



B. Actual growth curve: 16mm sound motion picture projectors per 100 teachers.

Fig. 8. Some growth comparisons (see text). Projector and Telephone graphs are on logarithmic scales.

SECTION V

STILL PROJECTORS

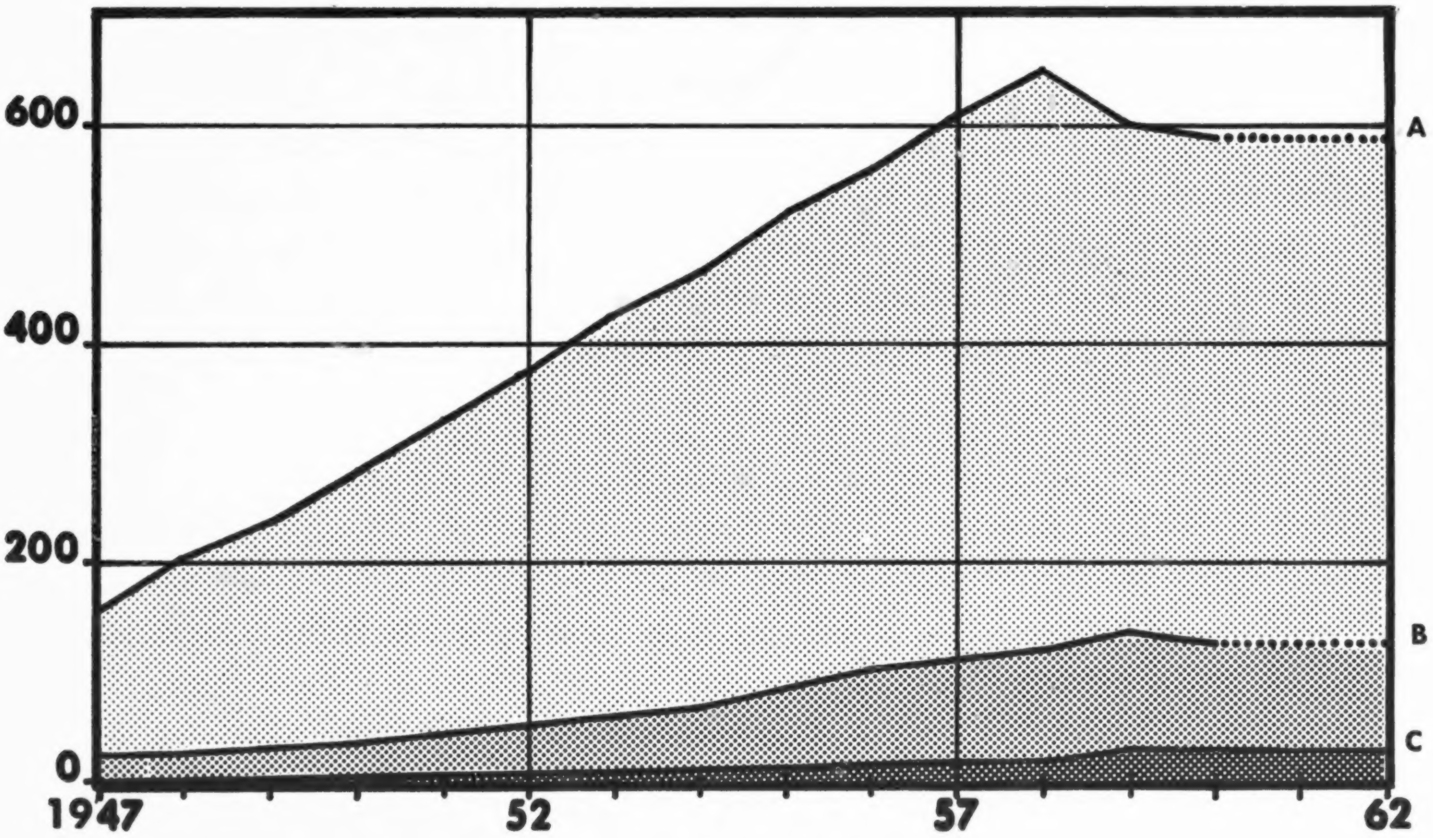
Slide/Filmstrip Projectors

The magic lantern gave way to the stereopticon or lantern slide projector in the late Nineteenth Century. The 35mm filmstrip or slide-film projector was introduced about 1915, but was not widely used as an educational tool until the late 30's. Because it was not possible for schools to purchase motion picture projectors during the war period, some invested in slide/filmstrip projector combinations, but purchases fell off when motion picture machines again became available after 1946. The period of rapid growth began in the early 50's when many companies began to produce filmstrips in quantity for the educational market.

Methodology

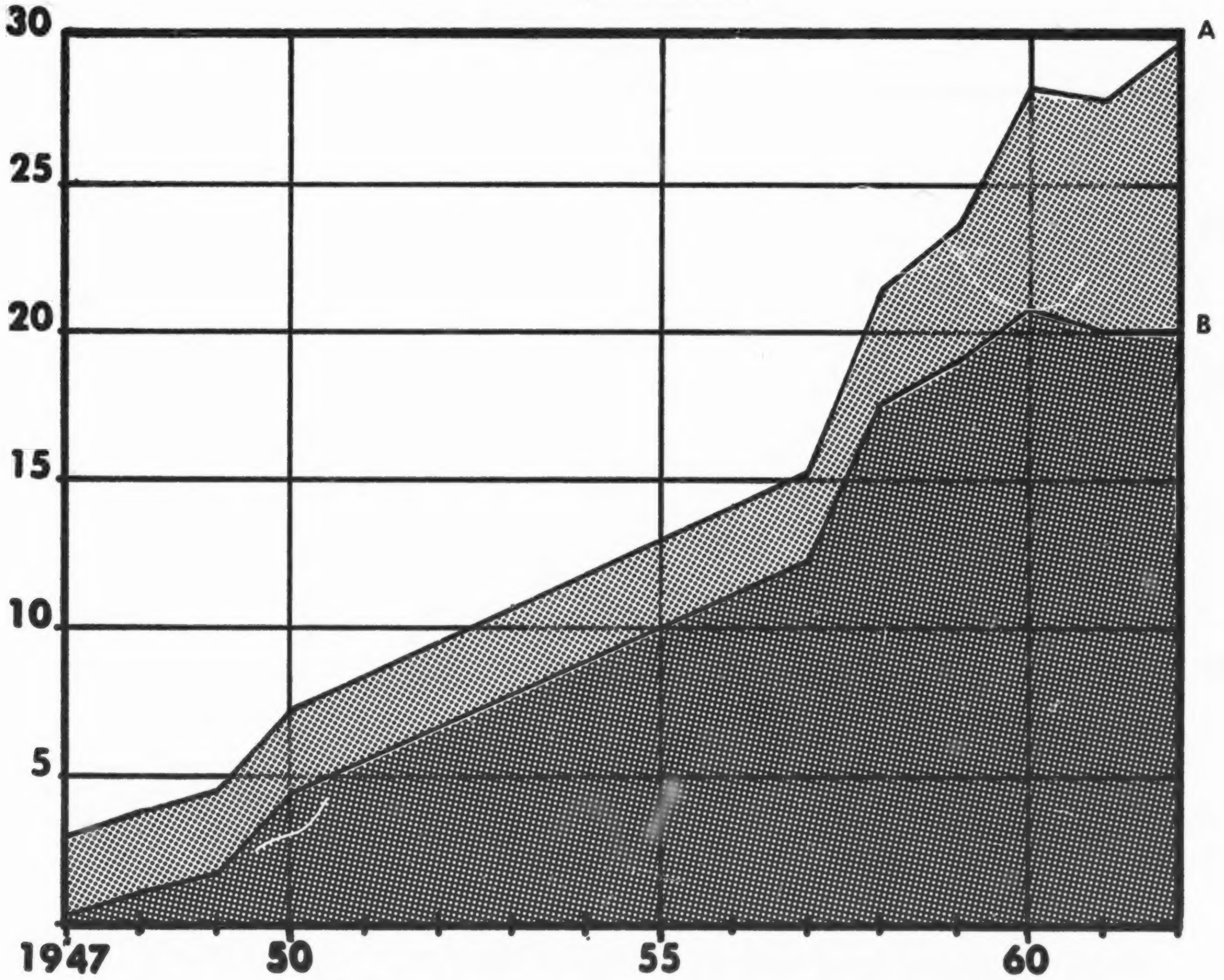
In general, the method of deriving the growth curve for slide/filmstrip projectors was the same as for 16mm sound projectors. Less information was available to validate the estimates and extrapolations, and none of the studies attempted to define what constitutes a slide/filmstrip projector. Although the Koon and Noble, and Golden studies list lantern slide projectors separately, the Census of Manufactures, with the exception of the year 1958, does not differentiate between slide and filmstrip machines. Projectors which show slides only are designed largely for the home market, while filmstrip and combination types are used in churches, businesses, and schools. Also, it is not known whether small "preview" type machines are included in the total figure. It is believed, however, that the totals reported here include all sound-filmstrip type machines, but not individual viewers.

Figure 9 shows annual production of slide and filmstrip projectors, broken into three groups; (1) projectors which show 2 x 2 slides only, (2) filmstrip and combination slide/filmstrip projectors, and (3), the proportion of these latter purchased by the public schools. (Figures 9, 10, 11, and 12 are based on Table XIII.)



ANNUAL SALES AND PURCHASES OF SLIDE AND FILMSTRIP PROJECTORS: 1947 - 1962
(in thousands)

Fig. 9. (Comparing annual sales with purchases by the public schools 1947 - 1962)
A. Annual U.S. sales of slide and filmstrip projectors, and slide filmstrip combinations,
B. Estimated number of filmstrip and slide-filmstrip combination projectors sold in the United States,
C. Annual purchases of filmstrip and slide-filmstrip projectors by the public schools. (See Fig. 10 for further information)



ANNUAL INCREASE OF SLIDE FILMSTRIP PROJECTORS IN PUBLIC SCHOOLS: 1947-1962
(in thousands)

Fig. 10. (Comparing purchases with annual increase after replacing obsolete machines 1947-62)

A. Annual purchases of filmstrip and combination slide- filmstrip projectors by the public schools,

B. Yearly increase after worn and obsolete equipment has been replaced.

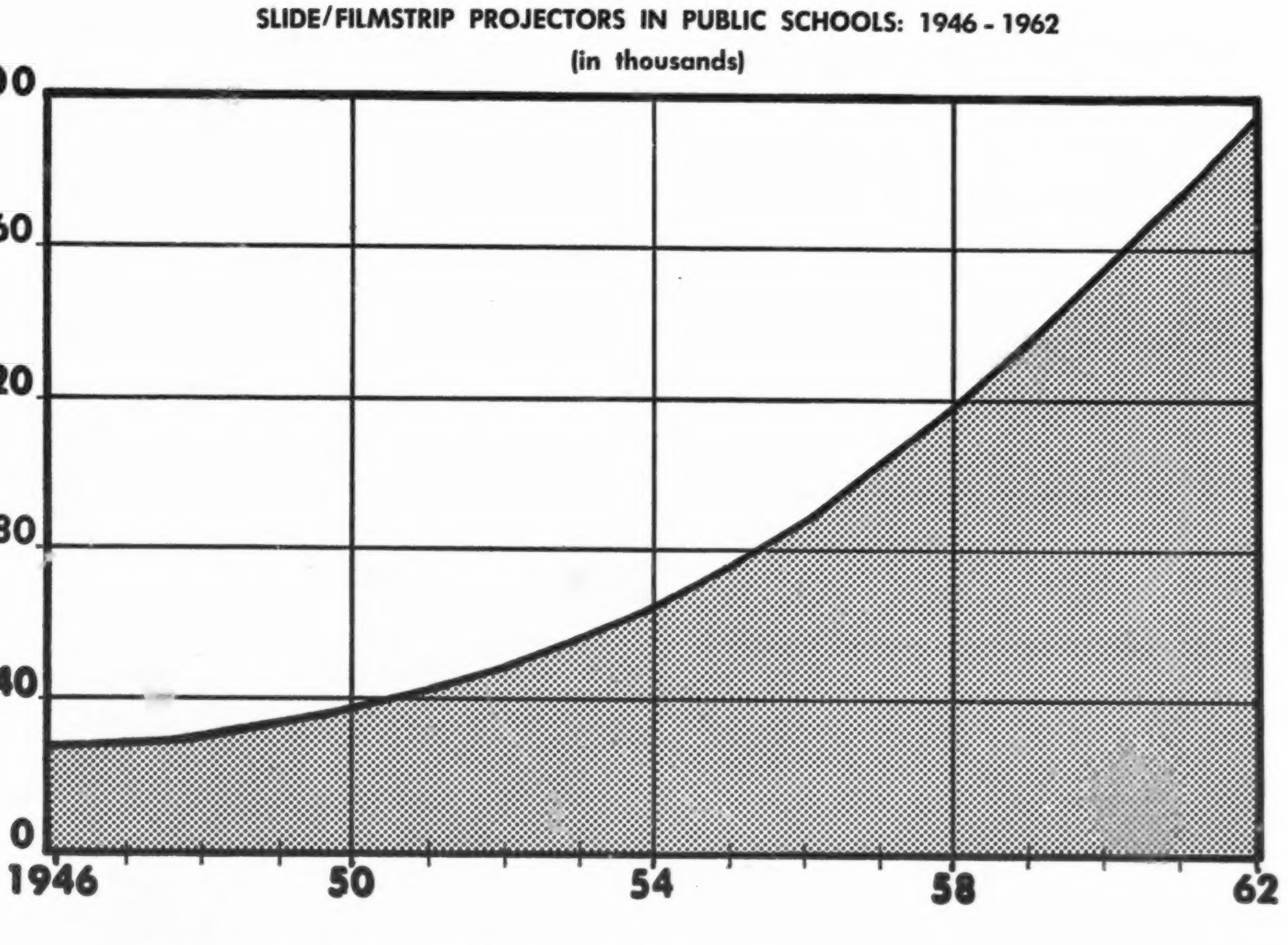
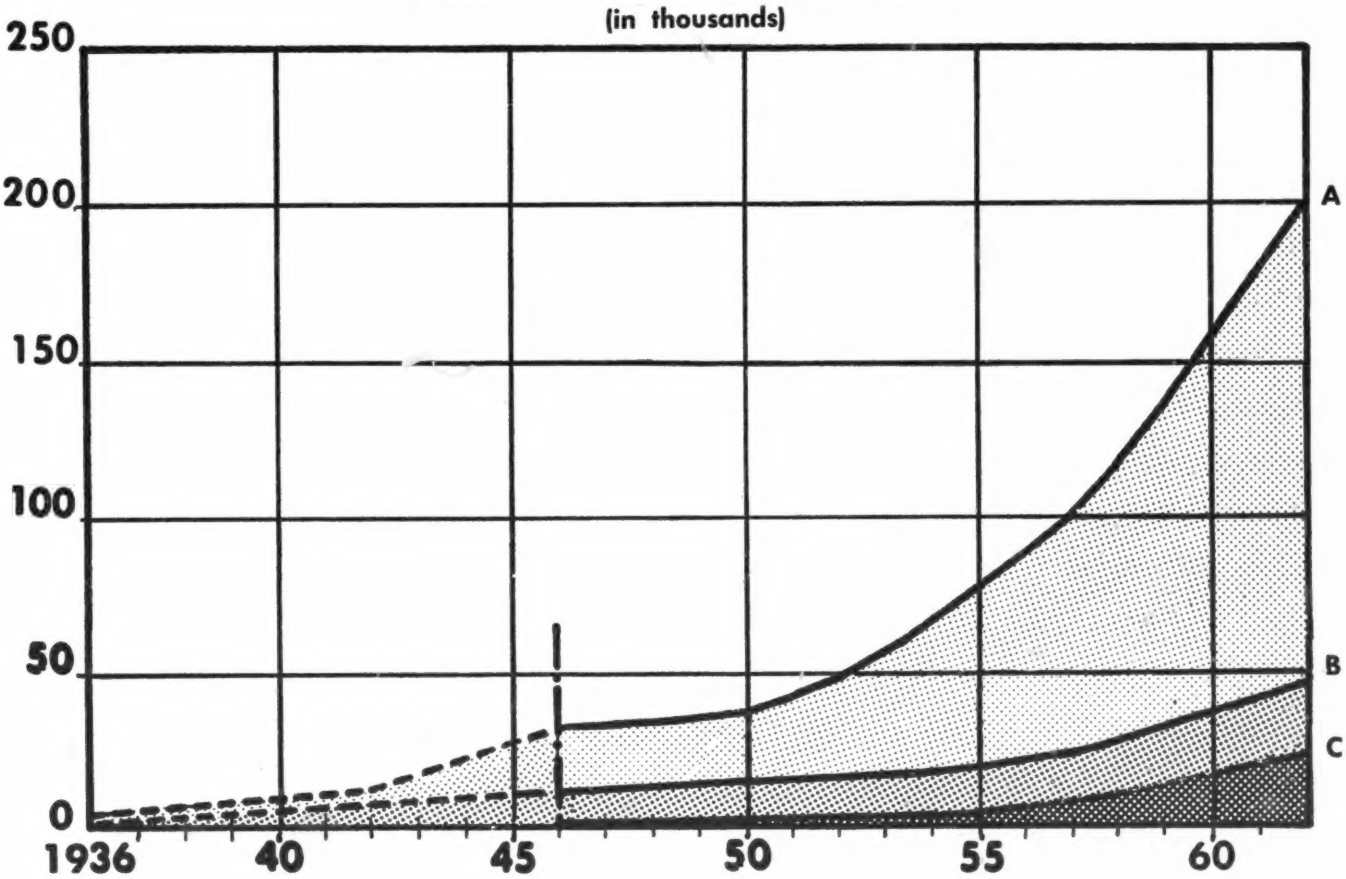


Fig. 11. Total number of filmstrip projectors and slide filmstrip combinations in use in the public schools, 1946 - 1962.



STILL PROJECTORS IN THE PUBLIC SCHOOLS: 1936 - 1962
(in thousands)

Fig. 12. Comparing the total numbers of slide filmstrip projectors with opaque and overhead transparency projectors for the years 1936 - 1962.

A. Slide filmstrip projectors.
B. Opaque Projectors.
C. Overhead transparency projectors.

Figure 10 is a magnification of the number purchased annually by the public schools, the top area representing that proportion of purchases used to replace worn or obsolete equipment. The yearly purchases increase steadily year by year. The jump after 1958 is obviously the result of NDEA. At this point in time, the number of projectors in need of replacement is increasing, so that, as with the motion picture projectors, NDEA is more significant as a means of replacing worn equipment than in raising the yearly increase to the public schools.

Total Number of Slide/Filmstrip Projectors in the Public Schools

The steady increase in the number of new projectors purchased by the public schools each year gives a total growth curve which rises steadily upward, with a slightly lesser slope after 1960 due to the increasing obsolescence factor. Figure 11 shows in detail the growth between 1946 and 1962. This curve is smoother than it would be had more plot points been available. However, the trend is fairly clear and, obviously, has made possible the well-known expansion in the educational filmstrip market enjoyed in the past decade. The keys to this expansion are, no doubt, both price and convenience.

Opaque Projectors

Except for the surveys showing the comparative status of the different media listed in Section III, there are no additional sources of information concerning the opaque projector. As will be noted from Table VI in Appendix C, not enough information was made available on the confidential industrial survey to develop figures due to the unwillingness of one large manufacturer to cooperate. The several national surveys ending with Godfrey's statistics were used.

The growth curve extrapolated from the existing plot points is depicted in Figure 12 as the middle line. The opaque projector has never been a smashing success as a piece of instructional technology over the many years it has been available due to its awkwardness, lack of light power, which requires thorough room darkening, size and weight. Since 1950, these characteristics have all been somewhat improved. This situation is reflected in the growth pattern. Growth has been extremely slow until the mid-fifties, when improvements made more widespread use feasible. NDEA funds have also helped to spur this increase, but not to any significant extent.

Overhead Transparency Projectors

The overhead transparency projector was developed for military use during World War II, and entered the educational scene immediately afterward. This projector can be used in a moderately well-lit room, and allows the instructor to work at the front of the classroom facing the students using pre-prepared materials in black and white or color, or creating them on the spot by writing or printing on clear plastic.

The growth curve is depicted by the lower line on Figure 12, and the sole sources of information are the 1954 NEA survey (6), the incomplete sales figures from the Finn-Campion survey, and the total for all public schools in 1961 from the survey by Godfrey (30).

In recent years a number of ingenious, relatively inexpensive methods of preparing transparencies for the overhead projector have come on the market in the form of diazo and heat processes. It is to be expected that these developments will stimulate the purchase of overhead projectors. However, after almost twenty years of availability, it could not be said that the overhead projector had been accepted whole-heartedly by the public schools up to this point in time. Evidence presented later on in this paper will support this contention.[29]

Still Projection Equipment Considered as a Whole

Considered as a whole, still projection equipment--filmstrip, slide, opaque and overhead projectors--represents a series of relatively uncomplicated and inexpensive technical systems for classroom use. With these systems a great variety of classroom communication tasks can be carried out. Pictorial, diagramatic and verbal information in compact and striking form, can be presented, discussed, reviewed, etc. Further, the materials for use in this equipment are relatively abundant and inexpensive.

In general, too, these systems are no worry and no threat to the teacher. The equipment is neither excessively heavy nor electronically complicated; it can be used easily by individual teachers. The materials require little care and minimum storage. Still projection, in one form or another, has been used in some phase of instruction for three-quarters of a century; it is not thought of in any context of "replacing the teacher." Most important of all, the educational value of still pictorial and graphic materials is conceded even by the most traditional of teachers.

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[29] A strange experience shared by the three authors at different times and different places during the last four years has been to observe the sudden discovery of the overhead projector by an experienced educational worker. These have included at least two deans of Schools of Education, several professors of various academic disciplines and a number of teachers at all levels. These experiences reinforce our feelings concerning the technological illiteracy of the educational sector.

Why, then, is the general stock of still projection equipment in the public schools at the level it is? Are 200,000 slide projectors of all shapes, sizes and conditions of servitude enough for over a million teachers and 36 million students in 100,000 schools? Certainly, 10,000 slide/filmstrip projectors accompanied by the proper materials would cause an educational revolution in Ghana. But what about the United States?

Perhaps the growth pattern--which is steepening--is more important than the total stock. Questions arise here, too. For example, must the overhead projector repeat the slow rate of growth undergone by the slide/filmstrip group? Up to this point in time, the curves are similar. Industrial reports, on the other hand, indicate that the overhead projector may be entering a period of fast growth.

SECTION VI

SOUND REPRODUCING AND RECORDING EQUIPMENT

Edison developed the first practical equipment for recording and reproducing sound in 1877, using a vibrating diaphragm and stylus to make indentations on a cylinder of tinfoil. Berliner introduced the disc recording pressed from a "master" in 1894. The phonograph and recording industry grew rapidly until the early 20's when the advent of radio changed the picture for a time. In the last two decades, the growth of the entire recording industry - players, components for players, recordings and tapes - has been phenomenal.

The public schools used a limited number of phonographs in the 20's and 30's for instructional purposes, but it was not until the 1950's that phonograph recordings were widely adopted, principally for use in the elementary classroom, for music appreciation generally, and for social studies, literature and physical education in the secondary school. The introduction of magnetic tape recorders in the late forties provided the first practical recording tool for classroom use, with the advantages of immediate playback and the possibility of erasing and reusing the tape. The tape recorder has found widespread use for group and individual instruction, and is the basis of most modern varieties of language laboratories.

Methodology

The estimates for this section were based, for the most part, on the general surveys and reports cited in Section III. There was available, however, one additional source--a general report on the electronic industry (16). The electronic industry report supplied total production figures for many kinds of instrumentation, such as phonographs.

The Growth Pattern of Sound Equipment

Figure 13 shows the growth patterns for record players, tape recorders, and language laboratories superimposed on the same graph. The major increase in the number of record players in the public schools began about 1952, probably because of the growing market in childrens' and educational recordings. Tape recorders were purchased from 1950 onward

SOUND EQUIPMENT IN THE PUBLIC SCHOOLS: 1936 - 1962
(in thousands of units)

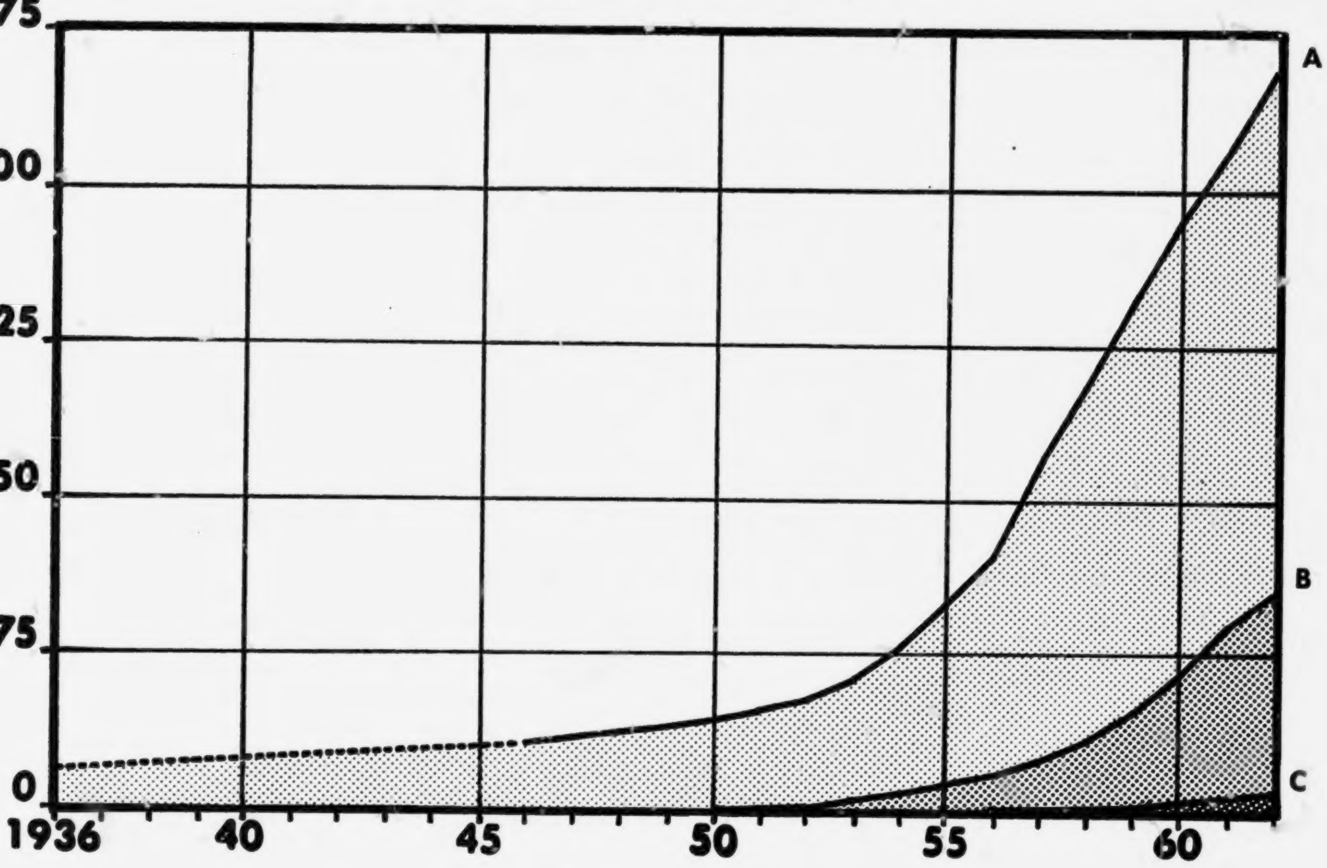

Fig. 13. Comparing total number of record players, tape recorders, and language laboratories in use in the public schools, 1936 - 1962.

A. Record players.
B. Tape Recorders.
C. Language Laboratories.
(for additional details see Fig. 14)

and are showing comparatively rapid growth. Language laboratories began their period of rapid increase in 1957, and these appear to have benefited more than any other educational medium from funds made available through the National Defense Education Act.

The growth of the language laboratory represents a special and unique case worthy of some additional comment. Figure 14 is an enlargement of the growth pattern of the language laboratory to which has been added (as the lower dotted line) estimates of this growth made by the U.S. Office of Education and by the investigators independently, prior to the development of additional hard data. When the figures from the Finn-Campion survey are related to the figures reported by Godfrey, the upper, solid line curve is the result.

The USOE estimates have been widely quoted and are, as can be seen, too conservative. Part of the discrepancy is, no doubt, due to difference of opinion as to what constitutes a language laboratory. However, we are now certain that our initial estimates, as well as those of the USOE, were far too low and that the upper curve is a more accurate description.

In either case, the growth pattern is explosive. And it is in this classical explosion curve that the unique situation of the language laboratory can be found. Prices for language laboratories vary according to units, capabilities, etc., but the range of most of them would run from about $7,500 to $17,500. This represents an investment, then, of about $100 million by the educational system in six or seven years. To this would have to be added the yet unknown investment in tapes and programed materials, maintenance and service costs, installation charges, room remodeling charges, etc. Never before in the history of American education has this kind of investment been made in so short a time for technical equipment to be used in instruction.

Almost overnight, the American educational system has acquired a whole new technology of instruction which begins with a new theory of teaching languages, extends through the preparation of all kinds of new materials (tapes, books, films) and ends in a laboratory loaded with electronic gear in which the individual student is brought together with the materials for instruction and practice in speaking and listening to a foreign language. It should be added that new capabilities for the electronic learning laboratory--the teaching of English, speech, business subjects, music, etc.--are being discovered daily.

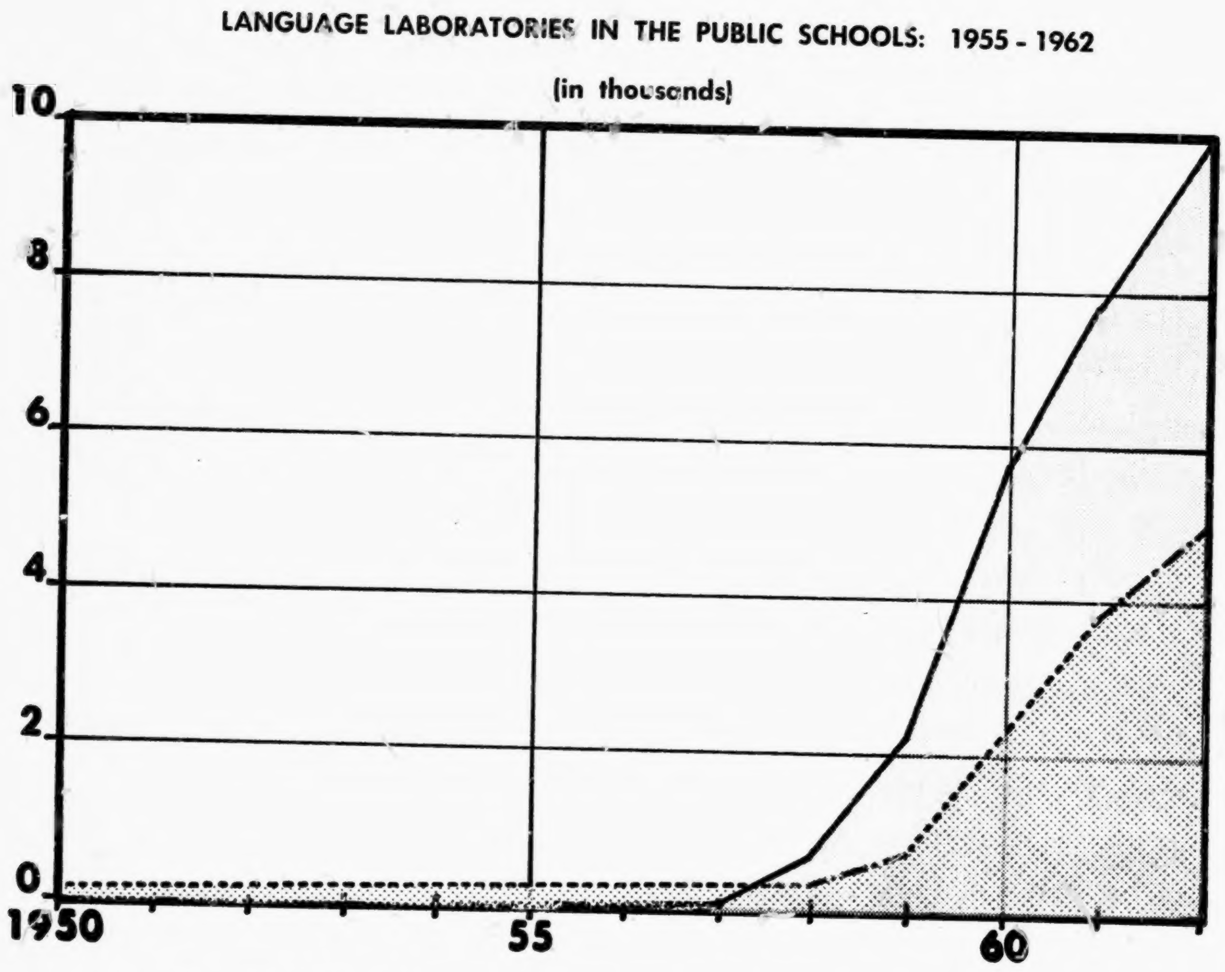

Fig. 14. Total number of language laboratories in the public schools, 1950 - 1962. The dotted line indicates estimates as compared to actual survey figures of the Technological Development Project.

There are several reasons for this development. There may even be reasons that are not yet clear. Consider these: (1) the new theories of language teaching and learning that emphasize speaking and listening and that are related to the work of the last twenty years in structural linguistics, (2) the general international situation with its demanding communication needs, (3) the educational race with Russia and the imitative reaction of a large segment of the American public which holds that if the Russians do it (teach several languages) in their schools, we must do it in ours (as far as known, the Russians do not have the language laboratory to any extent. They do have a heavy language curriculum), (4) the success of the Armed Forces with such techniques of language instruction, particularly the Army Language School at Monterey, (5) the status drive of middle and upper middle class Americans which somehow turned the educational criticism of the last decade concerning the "soft" (in this case, minimum foreign language) school into a demand for extended language instruction for their children in order to get them into an Ivy League college, (6) the status drive on the part of school superintendents and boards of education which led them to adopt the language laboratory as a status symbol, much as many corporation boards have adopted the computer for the same reason, (7) the need for diversification in portions of the electronic industry and the relative ease of constructing a laboratory out of existing "off-the-shelf" components, (8) the abundance of electronic recording equipment, hi-fi and stereo equipment and privately purchaseable recordings and tapes for language instruction within the general culture which, in turn, sowed the seed for acceptance in the schools.

The list could go on; it was made purposefully long and varied to emphasize the danger of ascribing one or two simple causes to a rather intricate development. However, all of the reasons listed above would not have brought about the explosion in growth that the data concerning the language laboratory reveal without the one necessary--and almost sufficient--reason. That reason was the National Defense Education Act. NDEA provided matching funds to the states for the improvement of foreign language instruction and a great deal of this money went into the language laboratory; NDEA also provided for teacher education in the new methods, for basic research, for the preparation of new materials, etc. The language laboratory is the classic case in the educational culture where the preparatory stages were all completed and a massive infusion of funds (savings to be spent on technological capital) from the Federal Government and from the Federal-stimulated states permitted a take-off in the Rostow sense.

SECTION VII

BROADCAST RECEPTION EQUIPMENT

Marconi invented the radio in 1895, and Fessenden first transmitted voice by radio in 1906. The first radio broadcast license was issued in 1920, and schools and universities actively experimented with radio in the 20's and 30's. In many ways, the heyday of educational radio was in the late 30's and early 40's. However, a second wave of interest and use seemed to come along about 1947. This phase extended into the television period where it leveled off.

Pictures were transmitted by telephone lines in 1908, by radio in 1921, and the first U.S. television license was issued in 1941. The intervention of World War II held off the widespread buying of television receivers until 1946, which also marked the beginning of the growth of television broadcasting stations. No construction permits for new broadcast stations were issued between 1949 and 1952 (the "freeze" period) while the standards and allocation of channels were revised, after which there was a period of spectacular growth in the number of commercial television stations, and the beginnings of educational television broadcasting.

Methodology

Radio receivers in the public schools are reported in almost all of the surveys comparing the different audio-visual media. Television receivers are reported only by Godfrey, and additional information has been obtained from confidential marketing information not reported here.

Because reception equipment is essentially a system of distribution only, its existence is related to the availability of programs and of programming sources--broadcasting stations. However, it was found that the statistics on educational radio stations from year to year were not readily available; furthermore, at the present time, without another survey it would be difficult to ascertain which of the existing radio stations were serving teaching and enrichment in the schools and which were operating at the cultural level for adults. The data on television stations is more readily available, although there is no hard data on the amount of direct school and college instruction provided by the educational channels.[30]

Growth Patterns of Radio and TV Receivers

Figure 15 shows the total number of radio and television receivers in use in the public schools over the period, 1936-1962. The pattern is clear. Radio remained fairly stable until after World War II when a large jump occurred. The growth pattern began to level off in 1954, coincidental with the advent of television. It has remained almost level since.[31, 32]

Television receivers have shown, again, an almost explosive growth pattern. This growth pattern extends over less than a decade. As with the language laboratory, there are many reasons for this quick growth. However, in addition to Federal funds, which don't show up much before 1959, credit has to be given the impetus provided by the Ford Foundation. This impetus may not have been so much in the form of school experimentation and demonstration by the Fund for the Advancement of Education in its National Program of

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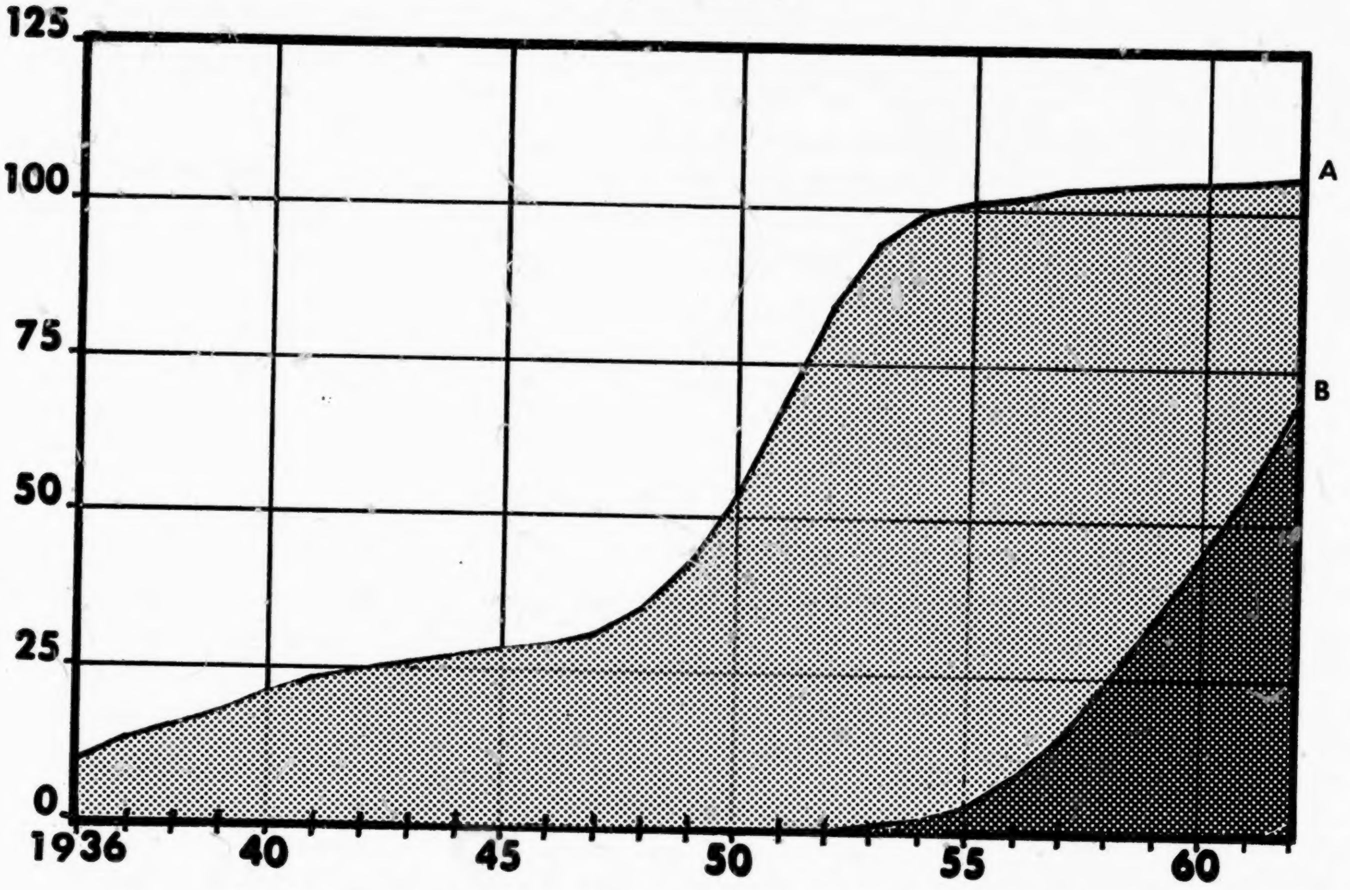
[30] The growth curve on educational radio stations would make an interesting picture. There is some excellent data in Frost (28) on the beginnings of educational radio stations and their subsequent decline. Frost found that 202 licenses had been issued to educational institutions from 1921 to December 31, 1936. The institutions were not able, for various reasons, to hold onto these licenses and, by 1936, 164 of the licenses had been lost, leaving only 38. Subsequently, of course, with the advent of ultra-short wave and, almost immediately thereafter, of FM broadcasting, the number of educational stations began once again to rise. At the present time, the number of educational radio stations in the United States is estimated to be about 180. The growth curve would look a little like the rocky mountains.

[31] The dangers of extreme optimism when related to a trade item and the trade press is well-illustrated in the case of radio receivers. Frost cites Broadcasting (June 1, 1936, p. 41), a respected trade paper, as stating that, at that date, three hundred thousand schools in the United States were equipped with radio receiving sets (28:110)

[32] In 1941, Seerly Reid, in a careful study of Ohio schools (54), found that there were about 4,000 radios in the schools of Ohio and about 500 central sound systems that could pick up broadcast signals. In 1936, Koon and Noble found that Ohio had over three times as many radios in the schools as the national average. It would have to be assumed, due to tremendous activity in the state, that this advantage had increased during the next five years. Reid reported that 90 per cent of the schools in the Cleveland area had radios due to the famous Cleveland program. Further, Reid's sampling was better than that of Koon and Noble and it is not certain that the data are compatible. Nevertheless, it may be that our curve is a little low for the first decade. From 1948 on, however, the data clearly support our growth pattern.



RADIO AND TV RECEIVERS IN THE PUBLIC SCHOOLS: 1936 - 1962
(in thousands)

Fig. 15. Comparing the total number of radio receivers with the number of television receivers in the public schools, 1936 - 1962. A. Radio. B. Television receivers.

Educational Television, but rather in the establishment and support of television stations and programming (NETRC) by the Fund for Adult Education and the parent Ford Foundation.[33]

The story on television stations is quickly told in Figure 16 which compares the growth of commercial television stations with educational stations. The end of the "freeze" is well marked in the sharp rise of 1952-53 which, at the same time, marks the beginning of the educational station. Compared with the beginnings of radio in the early 20's, educational television stations are off to a fairly good start. They represent a far more important and stable "tooling-up" of the educational sector in a decade than did the first ten years of educational radio stations. With the passage of the so-called Magnusen Bill, which provides certain Federal funds for the states to use in station construction, and with the increasing interest of the Federal Communications Commission in education, it is reasonable to expect even greater growth in the future. (For statistics, see Tables XV and XVI.)

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[33] Robert Hutchins stated that he felt the Fund for Adult Education did not put enough money into educational television stations to help them far enough over the difficult support period. (Interview with James D. Finn, August, 1962.)

GROWTH OF TELEVISION STATIONS: 1946 - 1961

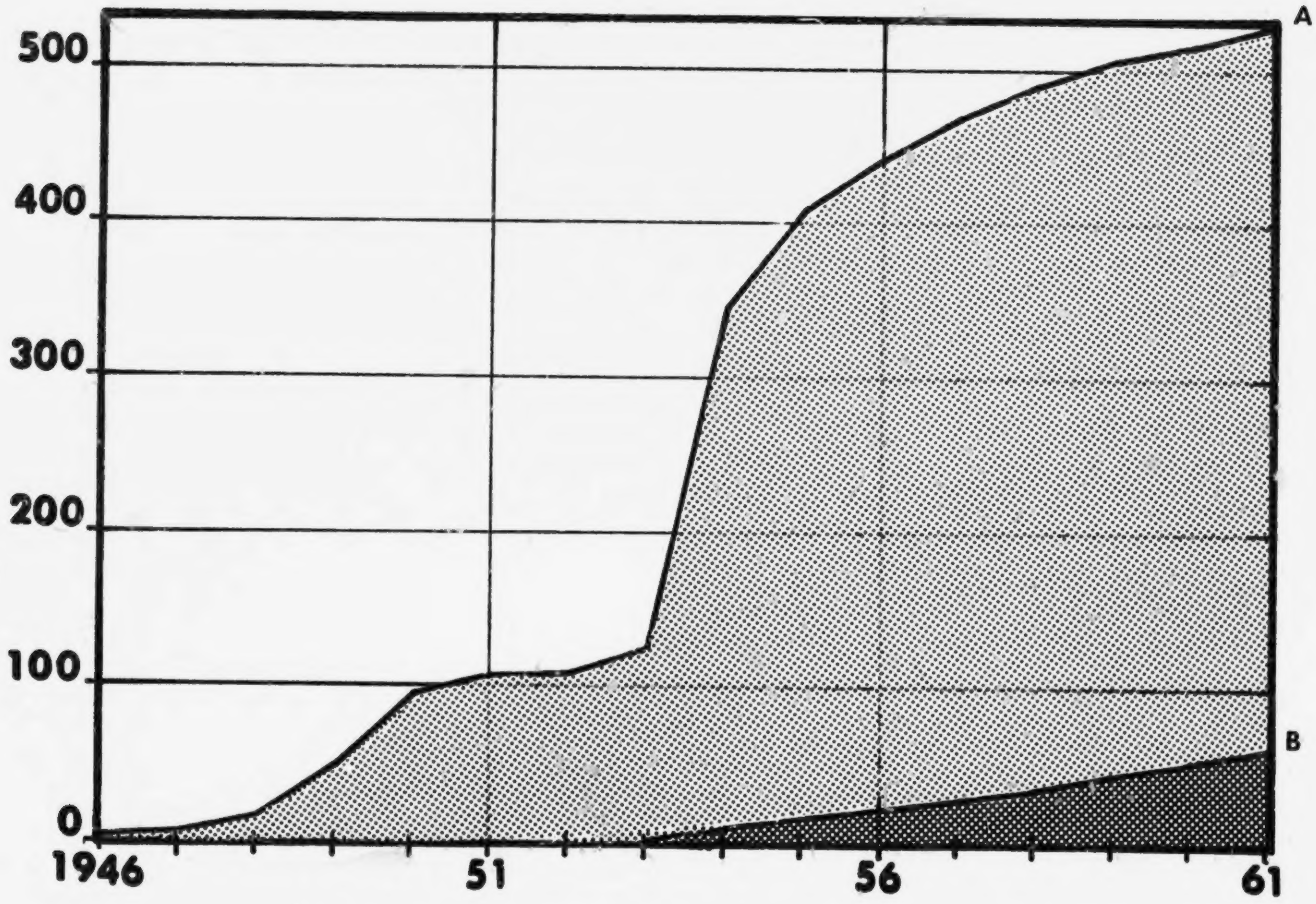

Fig. 16. Total number of commercial television broadcasting stations compared to the number of educational stations, 1946 - 1961.

A. Commercial Stations
B. Educational Stations

SECTION VIII

THE COST OF EQUIPMENT--INVESTMENT IN INSTRUCTIONAL TECHNOLOGY

In the earlier pages of this paper, repeated references were made to the concept of investment in technological capital. It was held that audio-visual equipment, as used in instruction in schools and colleges, is such an investment. As important as the growth patterns, then, are the costs of audio-visual equipment over the same period of time. When the costs are applied to the amount of equipment in the system, (less whatever have been saved by discounting and bidding procedures) the results are the dollar investment of the public schools in a form of technological (social overhead) capital. In a way, the investment explains the growth discussed in the preceding sections.

The cost analyses were made. Because comparatively adequate data were available over a relatively long period of time, the 16mm sound motion picture projector was subjected to an historical cost analysis. In order to arrive at some concept of the total investment in audio-visual equipment, another, more arbitrary procedure was used to arrive at an estimate of the overall investment of the public schools in audio-visual equipment. These findings will be reported in this section.

The Method of Deriving the Cost of the 16mm Sound Motion Picture Projector

Deriving the cost of motion picture projectors from year to year was not a simple process because of the variation in number of companies, each releasing a variety of models at different prices, and occasionally marketing a "super" model. One approach would have been to draw up a specification for a "basic" projector, and to consider only the one model from each manufacturer which most nearly met that specification. This was not readily feasible using the historical data available to the project, so an alternative approach was finally adopted which involved all but the "super" models put out by the various companies.

The average price (see (47)) of the various models available from each manufacturer was calculated and was then considered as the price for that year. An average was then computed for all manufacturers, and the price trends were plotted graphically. This "curve" was somewhat jagged in shape, and none too meaningful because of the different value of money through the depression, the war years, and the period of inflation that followed.

The striking fact about this curve (the dotted line on Figure 17) is that, over the 30-year period, the price of the 16mm sound projector has remained at about $500 in actual dollars. To gain a comparison of the cost in terms of the purchasing power of the dollar from year to year, these figures were then adjusted, using the Consumer Price Index for all items, so that all costs were fixed to the 1947-49 value of the dollar. The basic figures are tabulated in Table XVII in Appendix C.

The Cost Pattern of the 16mm Sound Motion Picture Projector

The solid line in Figure 17 represents the average cost of 16mm sound motion picture projectors in 1949 dollars. Note that from an initial cost of about $1,000, the price fell over a fifteen year period to about $400 and has remained constant at about this price in succeeding years. Note also the almost exponential form of the curve varied only by a small bump in the war years. This bump, we believe, was due to research and development costs incurred in making equipment rugged enough for military use.

Table XVII shows that the number of U.S. companies manufacturing motion picture projectors increased through the war period, reaching a maximum of thirteen companies in 1951, and decreasing to eight companies in 1962. Considering the changing number of companies and the variety of models, the corrected price curve is remarkably smooth.

Method of Deriving the Total Investment Figures

The history of the cost of the 16mm motion picture projector indicates that a point of stabilization which weathered the ups and downs of inflation and deflation was reached fairly quickly.[34] From what we knew of the development of other types of equipment, we

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[34] Again, this is only part of the story. Arranging to produce a totally new projector from research and development through tooling to a production line model would cost about $250,000, according to authoritative estimates we received from several industrial sources. Since the educational market obviously does not provide sufficient funds so that the manufacturer may recover this cost in a reasonable length of time, let alone his other costs, such as distribution, manufacturers have been reluctant to develop truly new products. This has led to the dressing up of old projectors in new clothes, so to speak, without any great changes in basic design, Since old stampings and many standard parts could be used, it

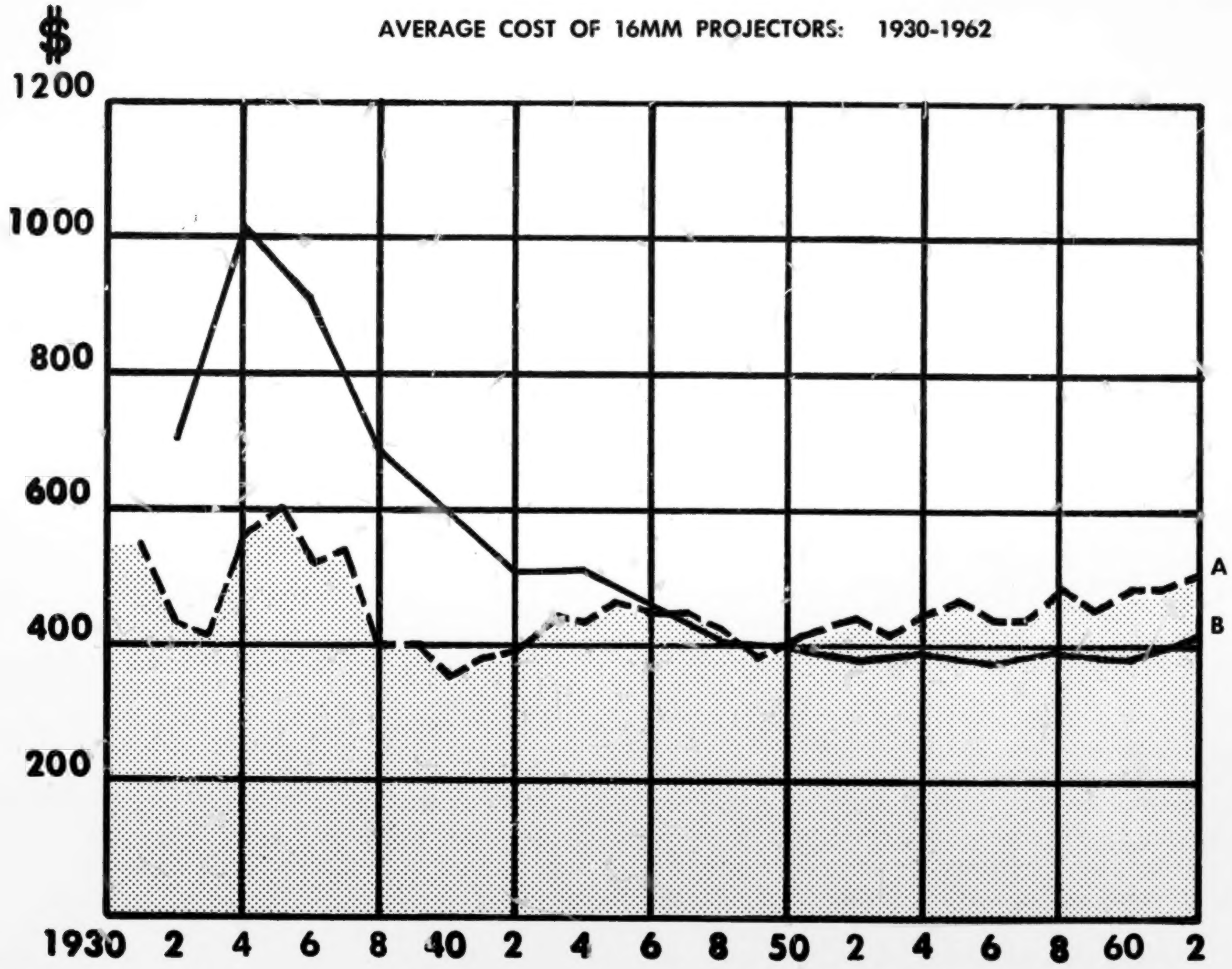

Fig. 17. Average cost of 16mm sound motion picture projectors in 1949 dollars and actual dollars. A. actual dollars. B. 1949 dollars

made the assumption that the other types, too, would have fairly well stabilized by this time. Acting on this assumption, we felt we could make a reasonable computation of the total investment of the public schools in a basic set of audio-visual equipment.

Nine pieces of audio-visual equipment were selected for this purpose. These pieces, listed in Table XVIII, represent the great preponderance of the investment in audio-visual equipment. We then assigned an arbitrary price based on the average replacement cost for these pieces in 1962 dollars. The prices were rounded off and also appear in Table XVIII.

TABLE XVIII

REPLACEMENT COSTS OF NINE ITEMS OF AUDIO-VISUAL EQUIPMENT IN 1962 DOLLARS

Item	Cost
16mm Sound Motion Picture Projector	$ 500
Slide/filmstrip Projector	100
Opaque Projector	300
Overhead Projector	300
Radio Receiver	100
Record Player	100
Tape Recorder	200
Television Receiver	250
Language Laboratory	$7,500

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required no great economic genius in the industry to keep the cost within bounds. This situation has probably contributed to the slow development of certain phases of instructional technology. Teachers have been forced to work with equipment which is too heavy, difficult to manage, etc., essentially because the equipment was being produced from old designs (and designs not specifically made for educational use).

Generally, administrators have been so unaware of these problems as to ignore them completely while demanding electric typewriters and newly designed headgear for football players. Professional teachers' groups are just as much at fault, as teachers, up to this point in time, pretty much take what some business manager buys them and do not relate their tools to their professional competence and needs. Recently, however, there are signs of change--mainly from the producing industry. Rather complete changes have been made in projection equipment by several major manufacturers in the past two or three years. Significantly, in one very new development--a self-threading projector--the price has gone up considerably. Faster improvement in the future, or another period of stabilization (stagnation?) remains up to the teaching profession as a whole and the pattern of administration, including the action of school boards.

It is recognized that these estimates are, to some degree, artificial, in that no discounting is considered. On the other hand, spare parts, tools, maintenance costs, screens, cases, tables, etc.--all a legitimate part of the investment--are also not counted. Further, there are, obviously, other items of equipment--such as micro-projectors--which would belong in a fully equipped instructional situation. The list in Table XVIII is basic; everything considered, it should represent the bulk of the investment in audio-visual equipment.[35]

Starting with the list and cost formula, a tabulation was made beginning with the year 1936, and based on the growth patterns presented earlier in this paper. The tabulations appear as Table XIX, Appendix C. Examination of Table XIX will reveal that the investment for these nine items of equipment to be of the order of a quarter of a billion dollars spread over a twenty-five year period.

The Growth Pattern of Overall Audio-Visual Equipment Investment

The growth pattern of this investment can be seen graphically in Figure 18. After a slow start, the rise was fairly consistent after 1948 until the fateful 1957-58 period (Sputnik--NDEA). Since that time, the rise has been explosive. Expenditures have almost doubled since 1958.

Expenditures since 1960 have been for items of equipment in the following order:

1. Language laboratories
2. 16mm sound motion picture projectors
3. Tape recorders
4. Television receivers.

Language laboratories alone have accounted for the expenditure of almost the same amount of funds as have the other eight items on the basic list.[36] This means that, while the dollar volume is rising in an encouraging fashion, the actual equipment becoming available is by no means rising as fast.

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[35] About 10 per cent might be added overall to cover obsolete equipment for which replacements were provided. The totals represent the existing stock for each year.

[36] It should be remembered that the basic list did not include equipment for television transmission.

CUMULATIVE GROWTH OF AUDIO-VISUAL EQUIPMENT IN PUBLIC SCHOOLS: 1936 - 1962
(in millions of dollars)

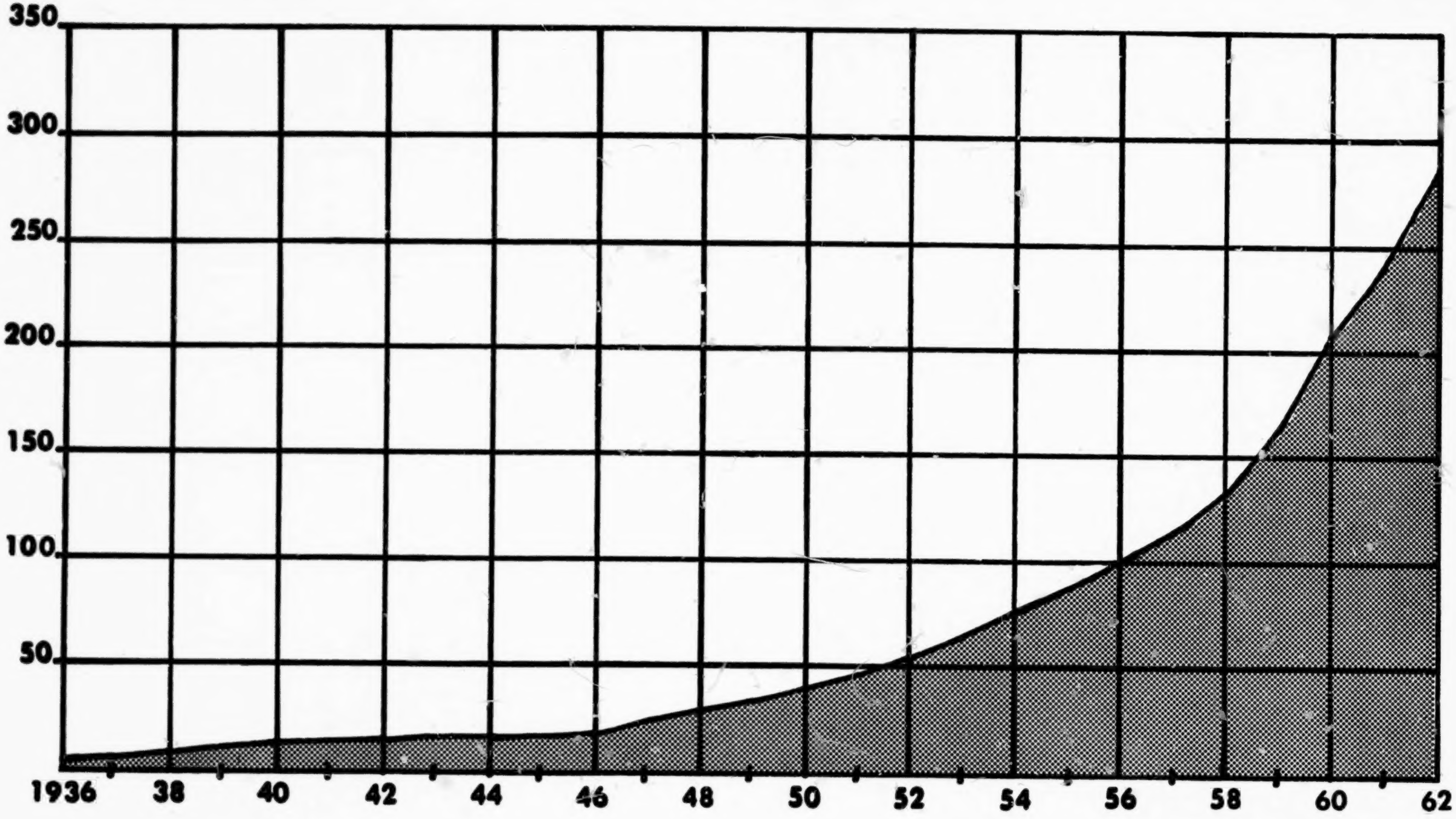

Fig. 18. Cumulative growth of Audio-Visual Equipment in the public schools: 1936 - 1962. Graph is plotted in millions of dollars at 1962 replacement costs.

A Brief Investment Comparison

The Statistical Abstracts of the United States: 1961 indicates that, for the year, 1958, the total expenditure on public education in the United States was about $13.5 billion (66:114). In 1958, the investment in nine basic items of audio-visual equipment was $18.3 million. This is a little over one-tenth of one per cent (.1%) of the total expenditure. That same year, capital outlay was a little over $2.95 billion. This investment was, obviously, mostly for construction. The investment in audio-visual equipment was about six-tenths of one per cent of this amount (.6%).

That same year, 1958, gross private domestic investment (excluding outlays out of current expenses) in equipment for non-farm producers was in excess of $20 billion. Equipment and constructions together ran to almost $34 billion. This includes no government investment and is confined to the business-industry sector. (66:493)

Making any set of assumptions you like from these figures, the disparity illustrates the poor-rich, technological-primitive problem. Assume, for example, that only 25 per cent of the private equipment investment is for equipment directly concerned with the production of items--stamping machines, plastic molds, etc. This would be $5 billion. Then add all non-productive equipment to the school list--buses, cafeteria equipment, etc.--as well as any items that could be remotely considered equipment for direct production--chalkboards, playground equipment, even school furniture. The great disparity would remain--practically untouched. And we have not considered the large business-industry outlay for equipment which comes from current expenses.

SECTION IX

EQUIPMENT FOR THE TEACHER--A COMMENT

The analysis presented in the foregoing pages was, in a way, a movement from macrocosm into microcosm. The rationale proposed in the large view, that the educational sector of the American economy was analogous to an underdeveloped culture surrounded by sophisticated cultures and subject to the same sorts of pressures for technological development. The reason suggested for this situation was drawn from Galbraith's theory of social balance which holds that the public sectors of the abundant economy are starved while the private and public-private sectors flourish and even luxuriate. This lack of balance and resultant parsimony toward education is the underlying cause of the relative technological backwardness of the educational sector.

It was further held that, due to many pressures on the underdeveloped culture in education, a technological revolution was likely. This revolution, if it were to take place, would probably follow the stages of growth identified by Rostow in his analysis of how traditional cultures became technological, high-consumption cultures. The key to this transition was the take-off stage, which was the result of political and psychological changes and the build-up of social overhead capital. Social overhead capital, in Rostow's sense, included such large items as transportation, power supply, education, etc.; following the analogy, the social overhead capital necessary for preparation for take-off was defined, at least in part, as the tools (audio-visual equipment) available to American educators. The accumulation of tools--for either a real culture or the miniature culture being considered--depends on the investment of funds. These funds must come from savings or from some outside source; it is impossible for a culture to develop funds for technological capital if it cannot somehow beat its population growth with production so that the savings may be put into tools, R & D and other types of technological capital.

An examination of the demography of the American public school system--the population growth of students and teachers over almost a century--revealed strenuous efforts on the part of the American people to at least maintain the status quo--and improve it if possible--under an avalanche of numbers and increasing educational demands. The school day and the school year were increased; the number of students graduating from high school doubled again and again; more teachers were found for the system. Considered in manpower terms alone--the general thought pattern for American education--great efficiency was achieved. In fact, it is highly probable that, in manpower terms, such efficiency has reached its height. In the meantime, of course, the demands on teachers and students for knowledge, skill and general performance has also skyrocketed.

A technological culture uses resources to solve its difficult problems; capital is applied massively to resources in order to develop and provide the technology necessary. The degree to which a culture may be ready for take-off may be detected by the degree of "tooling up" which has occurred. For this reason, the present study then went from the macrocosm to the microcosm and examined, in some detail, the growth patterns of audio-visual equipment used in instruction in the American public schools. It was assumed that the growth of this social overhead capital would give an indication of the degree to which a technological revolution was under way and whether or not, in this sense, American education was beginning, well into or had passed the take-off stage.

An Overall Analysis of the Growth Curves

Sections IV--VIII presented the growth curves we were able to develop for the standard items of audio-visual equipment commonly used in American public schools and for which data was available. These curves each tell their own story; together, they represent the rate of tooling up of the American educational system. It remains, then, to put these growth patterns into a larger and, it is hoped, more meaningful pattern.

The number of units of equipment used by the public schools from year to year is meaningful only when considered in terms of the number of classrooms, teachers, or pupils being served. (Table XX, Appendix C.) Because most of the items of equipment in this survey are used for group instruction, and therefore directly under the control of the teacher, the number of teachers sharing each unit of equipment (teachers/unit) was considered the most meaningful unit of measurement. Hence the information from Table XX has been retabulated in Table XXI by dividing the total number of teachers in the public schools for each year by the corresponding number of units of equipment. The result is depicted graphically in Figure 19.

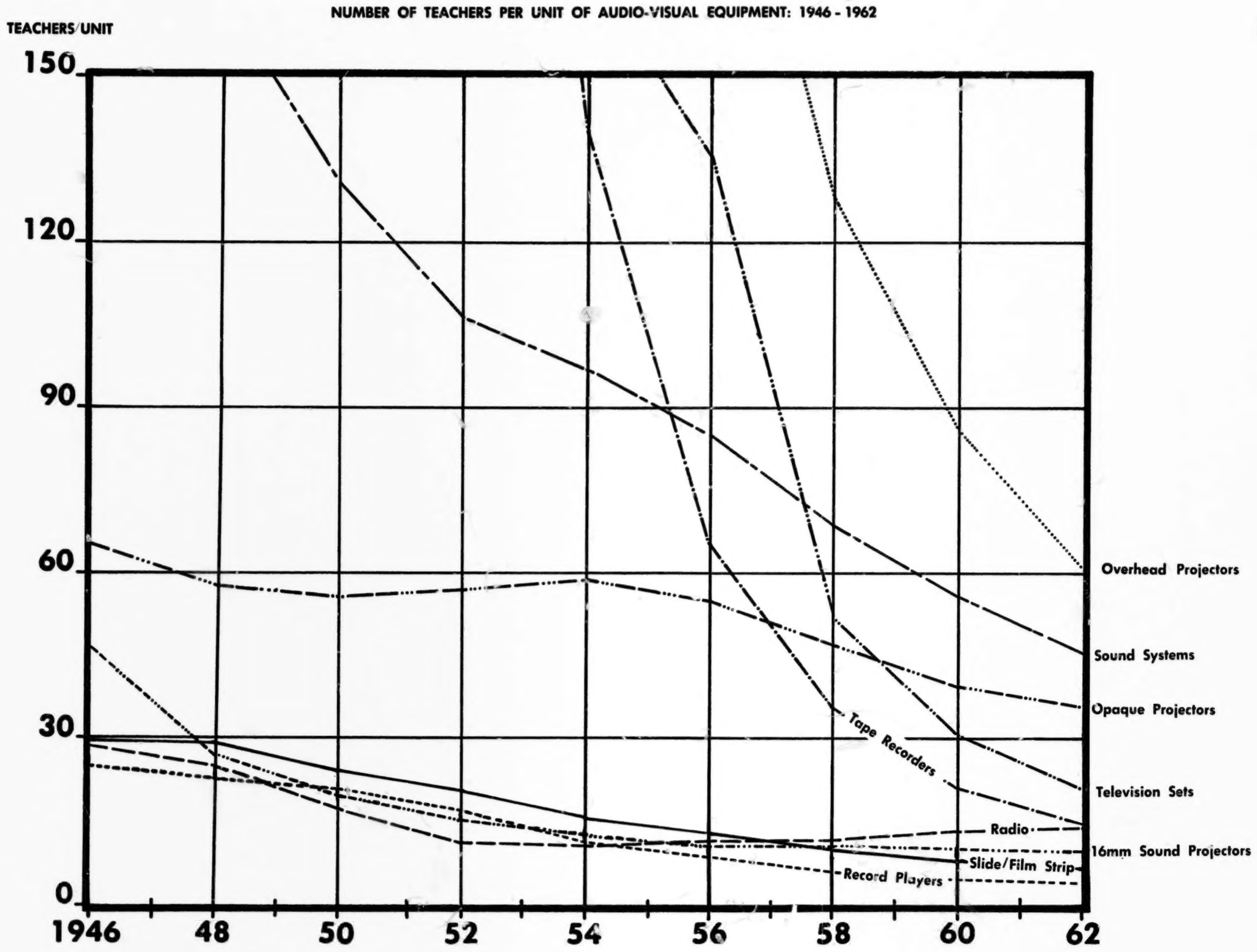

Fig. 19. Relative growth of nine key items of audio-visual equipment allowing for increase in the number of teachers. Note that the graph is inverted so that the more favorable ratios appear at the bottom.

With the exception of the opaque projector and central sound systems, the curves fall into two distinct groups. The lower ones are the well established "older" media, including motion picture projectors, slide/filmstrip projectors, record players, and radio receivers. They are grouped closely together and seem to follow a more or less similar trend. The upper group are the "new" media, television, tape recorders, language laboratores, and the overhead projector. This graph would seem to clearly differentiate between the "old" and "new" media, and it could be stated in words as follows:

> The "old" media are those developments introduced prior to World War II which have reached or are in the process of reaching the first plateau of their growth curve. The "new" media are innovations introduced since World War II and are still in the early stages of growth.[37]

This inverted form of graph gives excellent separation of the newer media and points to where their influence began to be significant (perhaps this could arbitrarily be defined as that point where there was one unit for every hundred teachers). However, for most purposes it would be more convenient to plot growth as an upward trend. For this reason, a second set of data was generated using an inverse function, the number of units of equipment per 100 teachers. This appears in Appendix C as Table XXII, and is plotted graphically in Figure 20. This gives better separation of the older media, which will greatly facilitate the following discussion.

In three instances, the growth curves have leveled off, which means that the increase in number of units of equipment was no longer more rapid than the increase in number of teachers, so that some kind of "saturation point" has been reached. Opaque projectors leveled off in 1950 at a very low point on the graph. This point represented less than two units per 100 teachers, and the curve did not keep up with the increase in teachers until 1956, when it again began to rise slowly. Classroom radios leveled off in 1954 and have continued to decrease in relation to the number of teachers, even though the total number of radios has increased slightly. Motion picture projectors leveled off about 1956, and did not regain their upward trend until 1958 when NDEA funds became available to augment audio-visual budgets.

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[37] We regard the term "new" or "newer" media useful only as legal language. Originally, it was apparently intended to differentiate between audio-visual and printed materials--a distinction now obliterated by programed instruction. However, there is a sense of "newer" as noted in the growth patterns. It will be interesting to see this term applied to computers and other, more complex, devices of the future.

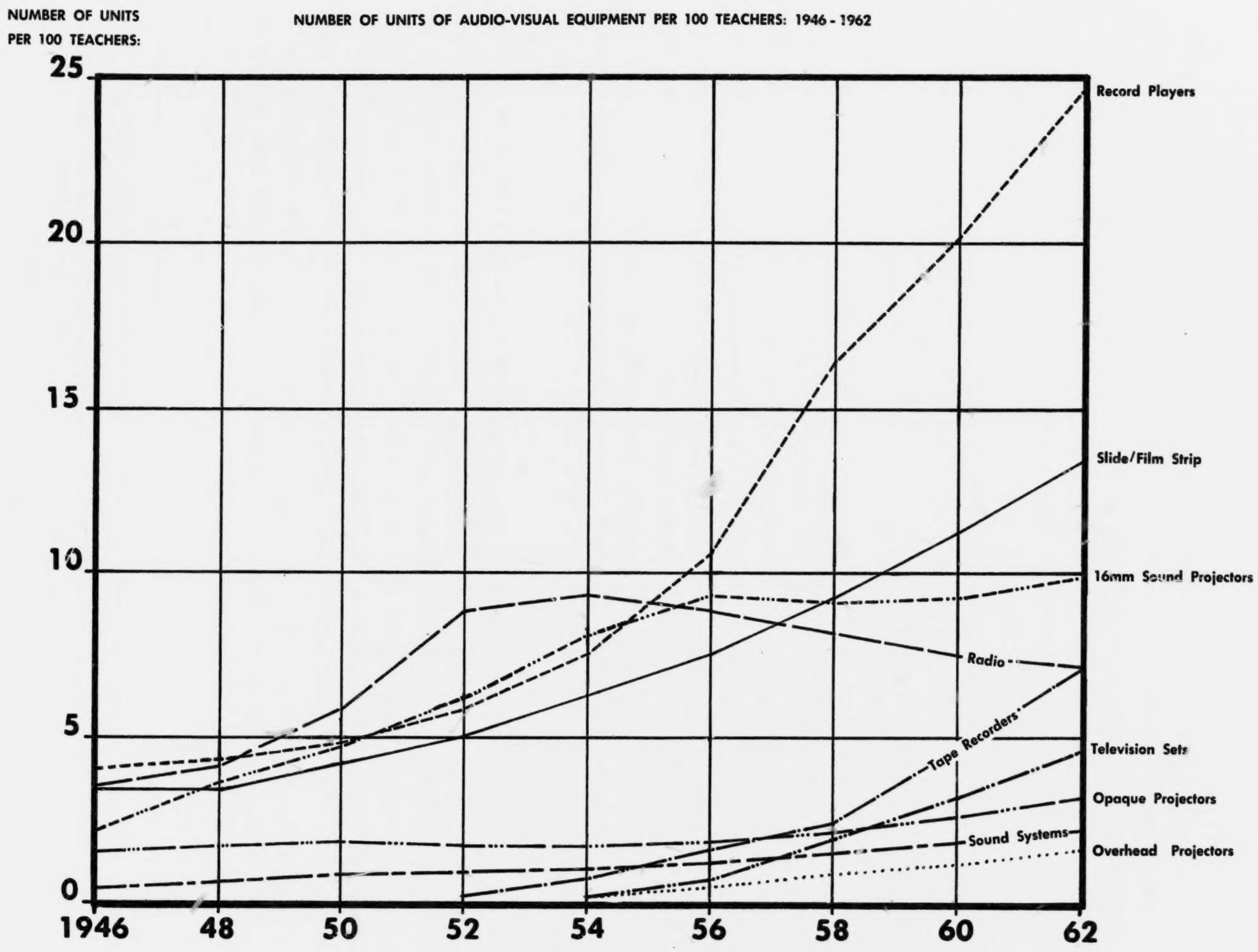

Fig. 20. Relative growth of nine key items of audi -visual equipment expressed in number of units per 100 teachers.

It seems illogical that the motion picture should have become the spearhead of the audio-visual movement when the cost of the equipment and materials are considered in relation to the other media. The motion picture remained the prime tool of the audio-visual educator until the early fifties, when a great diversification of media took place. The new media began to make their real impact about the middle fifties, and all began to claim a share of the limited audio-visual budgets which had not expanded sufficiently to absorb the new technology.

Many school systems were by this time reaching their goals for the number of motion picture projectors to meet their immediate needs, so that fewer new projectors were bought, and did not quite keep up with the increase in number of schools and classrooms. Money was not available for development beyond this level. The schools did need additional motion picture projectors. This fact is reflected by the increase since NDEA. It should also be remembered from the earlier discussion that in the mid-fifties the projectors purchased at the end of the war were in need of replacement. By the late 50's the obsolescence factor became highly significant, so that the number bought as replacements exceeded the number of new projectors added. For the years, 1956-57, this increase was in proportion to the growing number of classrooms. Since 1958, growth has resumed but at a much lower rate than previously.[38]

Of all the older media, only record players and slide/filmstrip projectors have continued their rapid increase. Both entered their period of rapid growth in the late 40's, but did not exceed the motion picture projector in number of units until the mid-fifties. This is surprising considering their lesser cost, and may be attributed to the lack of suitable materials for educational use until this later time.

Record players may show a sharp leveling when there is one record player in every elementary classroom, and at the present rate of increase this time is not far hence.[39] Then the emphasis will probably be toward better quality devices, so that there is little likelihood that purchases will diminish to any great extent if at all. The pattern for slide/filmstrip projectors is a little harder to guess. The addition of sound, and the increasing use of individual viewers will probably lead to a continuing growth for a long time to come.

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[38] An examination of the monies spent shows, too, that the schools continue to spend a rather large share of their audio-visual budgets on motion picture projectors. (See Table XIX.)

[39] If, however, the trend is toward individualized instruction, many more record players will be needed--at least three per elementary classroom.

Growth and Take-Off

The preceding remarks are geared to the curves as they show present trends. At the rate of acquisition of overhead projectors, for example, it will be years before every American school teacher can have the advantage of this useful device. On the other hand, the American teacher is being furnished with the beginnings of an adequate instrumentation. The question on which it is necessary to take a position is: has this instrumentation gone far enough to provide the social overhead capital necessary for take-off?

An interesting treatment of our data appears in Table XVIII. Here we present some comparative teacher/equipment ratios. Under the heading, "National Surveys," teacher/equipment ratios calculated from the Godfrey data and from our own estimates may be found. These, in turn, are compared with the results of three recent equipment inventories in three very technologically sophisticated school areas: the suburban schools in St. Louis County, twenty school districts in Los Angeles County, and the Los Angeles City Schools.

If the language laboratory and the central sound system are set aside as not applicable to the teacher/equipment ratio concept, it will be found that, nationally, the ratios vary from 4/1 to 99/1 for eight standard equipment items. For each single item, the ratios are in remarkable agreement.

It is our considered opinion that these ratios are not sufficiently low to justify the conclusion that the educational culture is in take-off. They do, however, suggest strongly that education is moving through the preconditions stage and, if certain trends are pushed more rapidly, will be able to reach take-off.

In order to define the take-off stage using only equipment as an indicator, it is necessary to make two assumptions. These assumptions are (1) that the educational system will continue to operate about the same way it has been operating, with the vast majority of teachers teaching groups of students, and (2) and adequate, easily available supply of materials is at hand for use with the equipment.

In the case of the first assumption, any large scale adoption of an organizational pattern like the Trump Plan, requiring large and small group instruction interspersed with individualized instruction, would make the existing equipment ratios meaningless. There are even some suggestions that all instruction should be put on an individualized basis, or that much of it be taken at home via television and teaching machines, etc.

There is no question but that somewhere in the take-off stage, the organization pattern will change radically. Further, other technological innovations involving teaching machines, computers, data transmission systems, translating machines, character generating and reading devices, etc. will change the instrumentation picture.[40] The organization plan used, the theories of teaching and learning applied and other factors will determine the instrumentation--and the instrumentation, itself, will have an effect on the theories and organization patterns. Hence, our assumption is, in this sense, "old-fashioned." However, if our reasoning outlined in Section I is sound, crawling must occur before walking; expectations derived from conventional technology yet to be applied must precede the world of the future. If there are enough projectors, there may be enough computers.

The second assumption deals with the razor-razor blades problem discussed earlier. One is useless without the other. Generally, the stock of materials has followed the hardware. We are working now, however, with an existing stock of materials that can supply a large share of the need and stimulate the production of more.

Operating from these two assumptions, we can foresee a transition to one or more new patterns of school organization, one or more new patterns of teaching and learning. During the transition, the existing technology will be worked in with the new technology. Little loss should occur.

The Threshold of Take-Off

The cost of take-off is great. Any attempt to calculate it illustrates Ward's point about the massive application of capital to resources. To develop such a concept, we selected the following items of equipment:

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[40] The Technological Development Project is publishing a monograph on future educational instrumentation.

16mm (or 8mm) sound motion picture projector
Slide/filmstrip projector
Overhead projector
Radio receiver
Record player
Tape recorder
TV receiver[41]

We then set the take-off ratio at 5/1 for five out of seven items of this equipment and have added the provision of one language laboratory per school. The opague projector, like the micro-projector, is considered as a specialized piece of equipment and should be included only where needed. There should be, then, at least one piece of each of five of these seven items of equipment for every five teachers in America, and one language laboratory per school.[42]

Proponents of programed instruction and/or television may be quick to suggest that the exclusive adoption of either or both of these newer approaches to teaching would cut this investment in half or less. It is not our intention, in this projection, to elaborate on the advantages and disadvantages of means and/or media. Even if television or ESP programed flash cards become the ultimate and exclusive conveyors of instructional messages, the process will be costly and the money will have to go into color TV wall screens and/or cranial electrodes instead of overhead projectors. The point is that it will have to go into technological investment, into social overhead capital for education.[43] Our thinking until now has been at one with the traditional society; it must become one with the traditional society; it must become one with the technological society. We are not suggesting the elimination of teachers, buildings or anything else. We are suggesting a large and important addition to the technological capital of instruction that, up to this point in time, has been neglected. We can afford to neglect it no longer.

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[41] We are well aware that different arrangements of this equipment could be made, e.g., a single amplifier and speaker system for projector, tape and record player. Such variations, however, do not change the main point.

[42] The "language laboratory" is considered as an electronic learning laboratory and would be useful, then, in any type of school. This equipment is definitely transitional to a higher level, more complicated organization of the future.

[43] Again the point concerning expectation should be emphasized.

BIBLIOGRAPHY

1. American Association of Colleges for Teacher Education. Teacher Education: Direction for the Sixties. A Series of papers presented at the Tenth Biennial School for Executives, Bemidji State College, Bemidji, Minnesota, August 21-27, 1960. Washington, D.C.: National Education Association, 1961.

2. Anderson, Charnel. History of Instructional Technology, I: Technology in American Education, 1650-1900. Occasional Paper No. 1. Los Angeles: Technological Development Project of the National Education Association, July 1962 (mimeo).

3. "Army's Projectors Follow the Flag," Business Screen (1945 Army Pictorial Issue). Chicago, Illinois: Business Screen Magazine.

4. Audio-Visual Education in City-School Systems. Research Bulletin, XXIV, No. 4. Washington, D.C.: National Education Association, December 1946.

5. Audio-Visual Education Department, Cooperating School Districts of the St. Louis Suburban Area. An Inventory of the Audio-visual Equipment and Materials Used in Cooperating School Districts of the St. Louis Suburban Area. Surveyed in January 1962, Published in May 1962 (mimeo).

6. Audio-Visual Education in Urban School Districts, 1953-54. Research Bulletin, XXXIII, No. 3. Washington, D.C.: National Education Association, October 1955.

7. Audio-Visual Equipment Standards. Los Angeles: Audio-Visual Education Association of California, Southern Section, 1961.

8. Brickell, Henry M. Organizing New York State for Educational Change, Albany, New York: The University of the State of New York and the State Education Department.

9. Broderick, Gertrude G. Educational AM and FM Radio, and Educational Television Stations, by State and City. Washington, D.C.: U.S. Office of Education, Department of Health, Education, and Welfare (Superintendent of Documents, mimeo), February 1961.

10. Committee on Educational Finance. Financing the Changing School Program. Washington, D.C.: National Education Association, 1962.

11. Cottrell, Fred. Energy and Society. New York: McGraw-Hill Book Company, 1955.

12. Council of Economic Advisers, Annual Report (January 12, 1962) in Economic Report of the President. Washington, D.C.: Government Printing Office, 1962.

13. Dale, Edgar. Audio-Visual Methods in Teaching. Revised Edition. New York: Holt, Rinehart and Winston, 1954.

"Educational Motion Pictures and Television." Journal of the SMPTE, LXVII, No. 5 (May 1958), 339.

Electronics, "Our Growing Markets." XXXV, No. 1 (January 5, 1962), 40.

Electronics Industry 1960 Fact Book. Washington, D.C.: Marketing Data Department, Electronic Industries Association; 1960.

Enrollment, Teachers, and School Housing in Full-Time Public Elementary and Secondary Day Schools. Washington, D.C.: U.S. Office of Education, Department of Health, Education and Welfare (Superintendent of Documents), 1960.

Ferry, W. H. "Caught on the Horn of Plenty." Bulletin, January 1962. Santa Barbara, California: Center for the Study of Democratic Institutions.

Finn, James D. "Automation and Education: III. Technology and the Instructional Process." Audio-Visual Communication Review, VIII, No. 1 (Winter 1960), 5-26.

______________ "New Techniques of Teaching for the Sixties," in Teacher Education, Direction for the Sixties. Washington, D.C.: The American Association of Colleges for Teacher Education, 1961.

Flory and Hope Studies

Flory, John. "The Economic Impact of the Audio-Visual Field." Journal of SMPTE, LXVI, No. 8 (August 1957), 458-461.

Flory, John and Hope, Thomas W. "Scope and Naure of Nontheatrical Films in the United States." Journal of the SMPTE, LXIIX, No. 6 (June 1959), 387-392.

______________________________ "Nontheatrical Films--An Interim Report." Journal of the SMPTE, LXIX, No. 1 (January 1960), 70.

______________________________ "Nontheatrical Films--Interim Report No. 2." The Journal of the SMPTE, LXX, No. 1 (January 1961), 1-2.

Hope, Thomas W. "Nontheatrical Films--Interim Report No. 3," Journal of the SMPTE, LXXI, No. 1 (February 1962), 139-142.

Ford, Edmund A. and Walker, Virgil R. Public Secondary Schools, Number 1. Statistics of Education in the United States, 1958-1959 Series. Washington, D.C.: U.S. Office of Education, Department of Health, Education, and Welfare (Superintendent of Documents), 1961.

___________________________________ Statistics of Education in the United States. 1958-59 Series, Number 1--Public Secondary Schools. Washington, D.C.: U.S. Office of Education, Department of Health, Education, and Welfare (Superintendent of Documents), 1961.

Frost, S. E., Jr. Is American Radio Democratic? Chicago, Illinois: The University of Chicago Press, 1937.

29. Galbraith, John Kenneth. The Affluent Society. Boston: Houghton Mifflin Company, 1958.

30. Godfrey, Eleanor P. A Study of Audiovisual Media in the Public Schools. (Prepublication information supplied by the author).

31. Golden, Nathan D. Survey of Motion-Picture Equipment in Colleges and High Schools in the United States and Its Territories, Part I. Washington, D.C.: Bureau of Foreign and Domestic Commerce, Department of Commerce, January 1941.

32. ________________ Survey of Motion-Picture Equipment in Elementary Schools in the United States, Part II. Washington, D.C.: Bureau of Foreign and Domestic Commerce, Department of Commerce, July 1942.

33. Harris, Seymour E. (editor). Higher Education in the United States, The Economic Problems. Cambridge, Massachusetts: Harvard University Press, 1960.

34. Health, Education, and Welfare Trends. Annual Supplement to the Monthly Health, Education, and Welfare Indicators. Washington, D.C.: U.S. Department of Health, Education, and Welfare, 1961.

35. Hoban, Charles F., Jr. and van Ormer, Edward B. Instructional Film Research, 1918-1950. Port Washington, New York: Special Devices Center, Office of Naval Research, 1950. Technical Report 2--TV-4.

36. Hoban, Charles F., Jr. Movies that Teach. New York: The Dryden Press, Inc., 1946.

37. Hutchinson, Joseph C. Modern Foreign Language in the High School: The Language Laboratory. USOE Bulletin No. 23. Washington, D.C.: U. S. Office of Education, Department of Health, Education, and Welfare (Superintendent of Documents), 1961.

38. Information obtained from Procurement Branch, Procurement and Distribution Division, Office of the Chief Signal Officer, United States Army.

39. Investing in People. A Symposium on Education and Economic Development. Oklahoma City: Frontiers of Science Foundation of Oklahoma, Inc., May, 1962.

40. Jensen, Herbert R. Motion Picture Projectors for Classroom Use. New York: Committee on Scientific Aids to Learning, 1941 (mimeo; at the time confidential).

41. ________________ Survey of School Experience with Motion Picture Projection Equipment (4 vols.) New York: Committee on Scientific Aids to Learning, 1940 (mimeo; at the time confidential).

42. Johnston, Marjorie C. and Seerley, Catharine C. Foreign Language Laboratories in Schools and Colleges, USOE Bulletin, No. 3. Washington, D.C.: U. S. Office of Education, Department of Health, Education and Welfare (Superintendent of Documents), 1959.

43. Koon, Cline M. and Noble, Allen W. National Visual Education Directory. Washington, D.C.: American Council on Education, 1936.

44. Kybal, Elba Gomez. "The Economics of Education," in Hughes, Emmet John (ed.), *Education in World Perspective.* New York: Harper & Row, 1962.

45. Moses, James A. "Trends of 16mm Projector Equipment in the Army." *Journal of the SMPTE,* LIX, No. 11 (November 1950), 527.

46. Myrdal, Alva. "The Power of Education," in Hughes, Emmet John (ed.), *Education in World Perspective.* New York: Harper & Row, 1962.

47. National Audio-Visual Association Industry Equipment Publications:
    (a) *The Blue Book of Audio-Visual Equipment.* Prepared by the Editors of *Business Screen* and The National Association of Visual Education Dealers, 1948.
    (b) Arendt, Edward F. (editor) *The NAVA Bluebook of Used 16mm Projectors.* Evanston, Illinois: National Audio-Visual Association, Inc., 1954.
    (c) *The Audio-Visual Equipment Directory.* A Guide to Current Models of Audio-Visual Equipment: Projectors, Reproducers, Recorders and Accessories. March 1953; March 1955; November 1956; February 1958; February 1959; January 1960; January 1961; January 1962. Fairfax, Virginia: National Audio-Visual Association, Inc.

48. *National Survey of Television Sets in U.S. Households--May 1961.* New York: Advertising Research Foundation, Inc., 1961.

49. Naval Document (Bureau of Ships, Code #662-D (logistics)).

50. Piel, Gerard. *Consumers of Abundance.* Santa Barbara, California: Center for the Study of Democratic Institutions, 1961.

51. Powell, John Walker. *Channels of Learning.* Washington, D.C.: Public Affairs Press, 1962.

52. *Press Release,* January 3, 1962. Washington, D.C.: U. S. Office of Education, Department of Health, Education, and Welfare.

53. Reid, Seerley. *Movie Projectors in Public High Schools,* Pamphlet No. 109. Washington, D.C.: Federal Security Agency, Office of Education, 1950.

54. ______________ *Radio in the Schools of Ohio.* Washington, D.C.: The Federal Radio Education Committee, U.S. Office of Education, 1942.

55. *A Report to Educators on Teaching Films Survey.* Published by Harcourt, Brace and Company; Harper and Brothers; Henry Holt and Company; Houghton Mifflin Company; The Macmillan Company; Scholastic Magazines; and Scott, Foresman and Company; 1948.

56. Rostow, W. W. *The Stages of Economic Growth.* Cambridge: The University Press, 1960.

57. Rugg, K.C. *Improving Instruction, Budgeting Your Audio-Visual Program.* Bloomington, Indiana: Indiana University, 1960.

58. Saettler, L.P. History of Instructional Technology, II: The Technical Development of the New Media. Occasional Paper No. 2. Los Angeles: Technological Development Project of the National Education Association, July 1962 (mimeo).

59. Sand, Ole and Miller, Richard I. The Principals Look at the Schools. A Status Study of Selected Instructional Practices. Washington 6, D.C.: National Education Association, April 1962.

60. Schlesinger, Arthur, Jr., "The One Against the Many." Saturday Review, XLV, No. 27 (July 14, 1962), 9-11, 54-55.

61. Schloss, Samuel and Hobson, Carol Joy. Fall 1961 Statistics on Enrollment, Teachers, and Schoolhousing in Full-Time Public Elementary and Secondary Day Schools. Washington, D.C.: U.S. Office of Education, Department of Health, Education, and Welfare, 1962.

62. Special Project on School Finance. Financing the Public Schools, 1960-1970. Washington, D.C.: National Education Association, 1962.

63. Statistical Summary of Education, Biennial Surveys of Education. Washington, D.C.: U.S. Office of Education, Department of Health, Education, and Welfare (Superintendent of Documents), 1960.

64. Trump, J. Lloyd and Baynham, Dorsey. Focus on Change: Guide to Better Schools. Chicago: Rand McNally & Company.

65. U.S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1957, Washington, D.C., 1960.

66. ______________________ Statistical Abstract of the United States: 1961. (Eighty-second edition.) Washington, D.C., 1961.

67. ______________________ U. S. Census of Manufactures: 1954. Industry Report MC54(2)-36D (Communication Equipment, etc.), MC54(2)-38B (Photographic Equipment, etc.). U.S. Government Printing Office, Washington, D.C., 1957.

68. ______________________ U. S. Census of Manufactures: 1958. Industry Report MC58(2)-36D (Communication equipment, etc.), MC58(2)-38B (Photographic equipment, etc.). U.S. Government Printing Office, Washington, D.C., 1961.

69. Ward, Barbara. "The Breakthrough to Modernity," in Hughes, Emmet John (ed.), Education in World Perspective. New York: Harper & Row, 1962.

70. ______________ The Rich Nations and the Poor Nations. New York: W.W. Norton & Company, Inc., 1962.

71. War Production Board Section, Policy Documentation File, log #817, National Archives.

72. Willey, Malcom M. and Rice, Stuart A. Communication Agencies and Social Life. New York: McGraw-Hill Book Company, Inc., 1933.

73. Woelfle, Dael. "Prophecy Fulfilled." *Science*, CXXV, No. 3503 (16 February 1962), 503.

74. Wolfman, Augustus. *1960 Annual Statistical Report, The Photographic Industry in the United States*, Number 5. New York: *Modern Photography* and *Photo Dealer* Magazines, 1960.

75. ————————. *1961 Annual Statistical Report, The Photographic Industry in the United States*, Number 5. New York: *Modern Photography* and *Photo Dealer* Magazines, 1961.

76. *Your Audio-Visual Program*. A Handbook for Principals. Los Angeles: Audio-Visual Education Association of California, 1961.

APPENDIX A

DEMOGRAPHIC STATISTICS

TABLE I

GROWTH OF SCHOOLS AND SCHOOL DISTRICTS, 1930-1960

Year	Number of Public Schools (in thousands)[1]				Average Number of Pupils Per School	Number of Public School Districts (in thousands)[1]
	Total Public Schools	Elementary		Secondary		
		All Elementary Schools	One Teacher Schools			
1930	262	238	149	24	99	
1932	259	233	143	26	102	128
1934	261	236	139	25	102	
1936	258	232	131	26	103	
1938	247	222	121	25	106	119
1940	223	198	114	25	115	117
1942	208	183	108	25	119	115
1944	199	170	96	29	118	111
1946	185	160	87	24	127	101
1948	172	147	75	25	140	95
1950	153	128	60	25	165	84
1952	148	124	51	24	180	71
1954	137	111	43	26	212	63
1956	130	104	35	26	241	55
1958	121	95	25	26	279	48

[1] *Health, Education, and Welfare Trends* (34:51)

TABLE II

PUPILS, TEACHERS, AND ATTENDANCE IN THE U.S. PUBLIC SCHOOLS, 1870-1960

Year	Number of Pupils[1]	Number of Teachers[2]	Pupil/ Teacher Ratio	High School Graduates as Percentage Population 17 Years Old	Average Length of School Term (days)	Average Number Days Attended Per Enrolled Pupil	Average Attendance as Percentage of Average Length of School Term
	(in millions)						
1870	6.872	0.201	34.3	2.0	132.2	78.4	59.4
1875	8.786	0.258	34.0		130.4	77.9	
1880	9.868	0.287	34.4	2.5	130.3	81.1	62.2
1885	11.398	0.326	35.0		130.7	83.6	
1890	12.723	0.364	35.0	3.5	134.7	86.3	64.1
1895	14.244	0.398	35.7		139.5	93.5	
1900	15.503	0.423	36.2	6.4	144.3	99.0	68.6
1905	16.468	0.460	35.8		150.9	105.2	
1910	17.814	0.523	34.0	8.8	157.5	113.0	71.7
1915	19.704	0.604	32.6		159.4	121.2	
1920	21.578	0.680	31.8	16.8	161.9	121.2	74.9
1922	23.239	0.723			164.0	130.6	
1924	24.289	0.761			168.3	132.5	
1925			31.1				
1926	24.741	0.814			169.3	135.9	
1928	25.180	0.832			171.5	140.4	
1930	25.678	0.854	30.1	29.0	172.7	143.0	82.8
1932	26.275	0.872			171.2	144.9	
1934	26.434	0.847			171.6	145.8	
1935			30.7				
1936	26.367	0.871			173.0	146.3	
1938	25.975	0.877		45.6	173.9	149.3	
1940	25.434	0.875	29.1	50.8	175.0	151.7	86.7
1942	24.562	0.859		51.2	174.7	149.6	
1944	23.267	0.828		42.3	175.5	147.9	
1945			28.1				

[1] Historical Statistics of the United States (65:207)

[2] Ibid., p.208

TABLE II (Continued)

Year	Number of Pupils[1]	Number of Teachers[2]	Pupil/ Teacher Ratio	High School Graduates as Percentage Population 17 Years Old	Average Length of School Term (days)	Average Number Days Attended Per Enrolled Pupil	Average Attendance as Percentage of Average Length of School Term
	(in millions)						
1946	23.300	0.831		47.9	178.6	150.6	
1948	23.945	0.861		54.0	177.6	155.1	
1950	25.111	0.914	27.5	59.0	177.9	157.9	88.8
1952	26.563	0.963		58.6	178.2	156.0	
1954	28.836	1.042		60.0	178.6	158.9	
1955			27.4				
1956	31.162	1.154[4]	27.0	62.3	178.0	158.5	89.0
1958	33.700[3]	1.267	26.6	64.8			
1960	36.400	1.410[5]	25.8				

[1] Historical Statistics of the United States (65:207)

[2] Ibid., p. 208

[3] Health Education and Welfare Trends (34:36)

[4] Statistical Abstract of the United States: 1961 (66:120)

[5] Ibid., p. 116. Teacher figures are for the fall of 1960, and would differ slightly from the annual figure.

APPENDIX B

CONFIDENTIAL SURVEY FORM

CONFIDENTIAL SURVEY FORM

CONFIDENTIAL SURVEY FORM

National Education Association
TECHNOLOGICAL DEVELOPMENT PROJECT

JUNE 1961

HISTORICAL SURVEY OF AUDIO-VISUAL EQUIPMENT SALES IN THE U.S.

Type of Equipment: ______________________________

Company Code Number________________

Could you please supply us with the following information:

(1) The number of functional units sold in the U.S. in the above equipment category for the years listed. Use either the calendar or fiscal year as set by company policy.
(2) The breakdown of sales into school, religious, industrial, and military groupings as far as is possible. If a breakdown is not possible, please enter total.
(3) Authoritative estimates for the early years should the sales records be no longer available.

As indicated in our letter, in order to keep this information confidential, the completed questionnaires should be returned to: Mr. Richard D. Morisse, CPA, Barro and Morisse, 9 Morland Place, Arcadia, California.

A self-addressed envelope is enclosed for your convenience. As the time of our project is limited by a government contract, we would especially like this information by ____________1961. Your trouble in preparing this is greatly appreciated. Thank you

Year	1960	1959	1958	1957	1956	1955	1954
Schools & Colleges							
Churches							
Business & Industry							
Government & Military							
TOTAL							

Year	1952	1947	1941	1940	1936	1931
Schools & Colleges						
Churches						
Business & Industry						
Government & Military						
TOTAL						

Totals figured on_____calendar year_____fiscal year (please specify).

APPENDIX C

BASIC DATA

TABLE VI

FINN-CAMPION SURVEY OF ANNUAL EQUIPMENT SALES, 1962[1]

Year	16mm M.P.	Filmstrip	Slide	Language Labs
1947		19,000	593	
1952		28,600	444	
1954		35,218	468	11
1955		40,003	623	21
1956	39,751[2]	43,210	696	29
1957	36,249	47,317	870	66
1958	37,388	53,515	1,116	977
1959	38,394	58,526	1,159	2,318
1960	43,136	66,500	1,228	4,923
No. of Companies Surveyed	5	6	5	13

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[1] No figures are published for sound-slidefilm, opaque, and overhead projectors, record players, and tape recorders, because less than four companies supplied sales data.

[2] Figures for earlier years not included because not all companies supplied data.

TABLE VII

GODFREY SURVEY (B.S.S.R.) OF AUDIOVISUAL EQUIPMENT IN THE U.S. PUBLIC SCHOOLS, 1961[1]

Type of Equipment	Total Number[2]	Error of Estimate[3]
16 mm Sound Projectors	125,500	± 2020
Combination Slide-Filmstrip Projectors	136,000	± 2940
Record Players	364,800	± 7250
Tape Recorders	88,200	± 1930
Radio Receivers	108,600	± 3970
Television Receivers	50,000	± 2380
Portable Public Address Systems	30,300	± 1070
Central Sound Systems	28,700	± 980
Overhead Projectors	13,900	± 750
Opaque Projectors	39,400	± 1080
Filmstrip (only) Projectors	33,000	± 2830
2 x 2 Slide (only) Projectors	6,400	± 700
Language Laboratory Installations	4,600	

[1] A survey conducted by Eleanor P. Godfrey for The Bureau of Social Science Research, Inc. under contract with the U.S. Office of Education, 1961. (To be published late 1962.)

[2] Based on sample data. The survey replies were stratified by both size (11 categories) and region (8 categories). The national estimate is the sum of these 88 estimates.

[3] The figures given represent the upper and lower limits of the national estimate at the 95% level of confidence.

TABLE VIII

GOLDEN STUDY OF MOTION PICTURE AND FILMSTRIP PROJECTORS IN U.S. ELEMENTARY SCHOOLS (1942) HIGH SCHOOLS AND COLLEGES (1941)[1]

	Elementary Schools (1942)	Public High Schools (1941)	Colleges (1941)	Private and Parochial (1941)	Total H.S., Col., Priv. (1941)	Estimate for Public Schools[2] (1942)
Questionnaires Sent Out	40,000	23,617	1,725	2,935	28,277	
Replies (#) (%)	25,703 (64%)	14,725 (62%)	1,424 (83%)	2,341 (80%)	18,490 (65%)	
Silent 16mm Projectors[3]	6,055	-	-	-	6,037	16,000
Sound 16mm Projectors	4,373	-	-	-	6,374	14,500
Slide-Filmstrip Projectors (silent & sound)	2,690	-	-	-	4,325	11,900

[1] The 1941 survey was entitled Survey of Motion Picture Equipment in Colleges and High Schools in the United States and its Territories (31). The figures for U.S. Territories have been eliminated from the statistics quoted.

[2] The public school estimates were mathematically derived from the survey data presented here, and modified after discussion with Nathan D. Golden who conducted the survey.

[3] It would be interesting at a later date to account for the transition from silent to sound motion pictures in the schools.

TABLE IX

QUANTITY AND VALUE OF EQUIPMENT SHIPPED BY U.S. MANUFACTURERS IN THREE CENSUS YEARS[1]

Product	1947		1954		1958	
	Quantity	Value	Quantity	Value	Quantity	Value
16mm sound projectors	57,409[2]	$17,906,000	46,989	$19,473,000	36,723[2]	$12,183,000
Slide projectors		-		-	520,128	$18,132,000
Filmstrip projector & combinations		-		-	134,766	$ 5,962,000
Slide and filmstrip projectors (total of above)	150,919[3]	$ 5,584,000	496,108[4]	$18,356,000	654,894	$24,094,000
Industrial CCTV including cameras		-		-	-	$ 7,710,000
Recorders: tape, wire, and disc		-	293,000	$27,110,000	482,086[4]	$44,834,000

[1] U.S. Bureau of the Census, Census of Manufactures, 1954(67), 1958(68). Total shipments include interplant transfers.

[2] Includes 16mm optical sound, 16mm magnetic sound, and combination types.

[3] All still projectors (slide and filmstrip) were grouped together for the years 1947 and 1954.

[4] Estimates based on cost data.

TABLE X

EQUIPMENT IN PUBLIC SCHOOL SYSTEMS EXTRAPOLATED FROM NATIONAL EDUCATION ASSOCIATION SURVEY, 1946

EQUIPMENT	CITIES REPORTING[1]	CITIES NOT REPORTING[2]	RURAL SCHOOLS[2]	TOTAL
16mm Sound Motion Picture	5,582	5,620	6,380	17,580
16mm Silent Motion Picture	4,098	5,440	7,800	17,340
Slide & Filmstrip	7,725	9,810	10,860	28,400
Opaque	2,663	4,080	5,850	12,590
Radios	8,384	10,890	9,750	29,020
Record Players	7,944	10,890	14,630	33,460
Central Sound Systems	823	1,360	980	3,160
Recording Equipment	646	1,360	980	2,990
Still Cameras	637	1,360	980	2,980
Motion Picture Cameras	348	-	-	348

[1] NEA Research Bulletin, (4)

[2] Estimate based on available data.

TABLE XI

EQUIPMENT IN PUBLIC SCHOOL SYSTEMS EXTRAPOLATED FROM NATIONAL EDUCATION ASSOCIATION SURVEY, 1953-1954

EQUIPMENT	CITIES REPORTING[1]	CITIES NOT REPORTING[2]	RURAL SCHOOLS[2]	TOTAL[3]
16mm Sound Motion Picture	21,529	21,680	41,090	84,300
16mm Silent Motion Picture	2,706	1,280	1,000	4,980
F.S. and Slide Projector	22,600	15,300	29,610	67,500
Overhead	841	760	500	2,110
Microprojector	1,228	640	800	2,670
Opaque	6,722	2,550	8,890	18,150
Record Players	15,777	15,330	47,380	78,490
Screens	37,435	30,670	38,500	106,600
Radios	28,970	25,750	44,420	99,140
Television	1,647	200	100	1,950
P.A. Systems	4,444	2,560	4,000	11,000
Still Cameras	1,757	1,280	2,960	6,000
Motion Picture Cameras	813	510	200	1,520

[1] NEA Research Bulletin, (6).

[2] Estimates based on available data.

[3] Discrepancies from totaling first three columns due to rounding.

TABLE XIII

ANNUAL PRODUCTION OF FILMSTRIP AND SLIDE PROJECTORS, 1946-1962
(Related to Number of Units in the U.S. Public Schools)

Year	Annual Production and Shipments			Purchased by Education		Purchased by Public Schools		Obsolescence and Increase in the Public Schools		
	Total Shpts.	Exports	U.S. Shpts.	% U.S. Shpts.	Number	% Educ.	Number	Obsolete	Annual Increase	Cumulative Total
1936										5.0
1937										6.2
1938										7.3
1939										8.5
1940										9.6
1941										10.8
1942										11.9
1943										17.2
1944										22.5
1945										27.8
1946										28.4
1947	151.0	15.0	145.9	3	4.4	70	3.0	2.8	.2	28.6
1948	196.8	19.7	187.1	3	5.6	70	3.9	2.8	1.1	29.7
1949	242.6	24.3	218.3	3	6.5	70	4.6	2.8	1.8	31.5
1950	288.4	28.8	259.6	4	10.4	70	7.3	2.8	4.5	36.0
1951	334.2	33.4	300.8	4	12.0	70	8.4	2.8	5.6	41.6
1952	380.0	38.0	342.0	4	13.7	70	9.6	2.8	6.8	48.4
1953	425.8	42.6	383.2	4	15.3	70	10.7	2.8	7.9	56.3
1954	471.6	47.2	424.4	4	17.0	70	11.9	2.8	9.1	65.4
1955	517.4	51.7	465.7	4	18.6	70	13.0	2.8	10.2	75.6
1956	563.2	56.3	506.9	4	20.3	70	14.2	3.2	11.0	86.6
1957	609.0	60.9	548.1	5	21.9	70	15.3	3.0	12.3	98.9
1958	654.9	65.5	589.4	6	29.5	73	21.5	3.9	17.6	116.5
1959	602.1	60.2	541.9	7	32.5	73	23.7	4.6	19.1	135.6
1960	594.9	59.5	535.4	7	37.5	75	28.1	7.3	20.8	156.4
1961				7	(Estimate)		28.4	8.4	20.0	176.4
1962					(Estimate)		29.6	9.6	20.0	196.4

TABLE XIV

TOTAL NUMBER OF LANGUAGE LABORATORIES IN THE U.S., 1950-1962

Year	Finn-Campion Survey of Manufacturers[1] (public schools only)	Other Surveys and Estimates[2]						Total
		Elementary		Secondary		Higher Education		
		Public	Private	Public	Private	Public	Private	
1950						100[3]		100
1951								
1952								
1953								
1954	7							
1955	20							
1956	30							
1957	70			49[4]	15[4]	90[4]	150[4]	304
1958	740							
1959	2,302			500[5]		240[6]		740
1960	5,740							
1961	7,800	100[6]		3,000[5]		700[5]		3,800
1962	10,000	157[6]		4,000[7]		753[6]		4,910

[1] These figures are modified slightly from the data obtained from the survey (Table VI) to account for sales to colleges, industry, and government, and to compensate for companies not included in the survey. The figures for 1961-62 are estimates based on Godfrey's survey and the estimates of well informed individuals.

[2] These estimates do not necessarily use the same definition of a language laboratory as the Finn-Campion Survey, so that considerable differences are likely to occur without really being in conflict. Some authorities would not consider installations without a recording facility to be classifiable as language laboratories.

[3] Hutchinson, Joseph C., (37)

[4] Johnston, Marjorie C. and Seerley, Catharine C., (42)

[5] Estimates by Joseph C. Hutchinson, USOE.

[6] Campion's estimate.

[7] Estimate from a special report by School Management Magazine.

TABLE XV

PRODUCTION OF RADIO AND TELEVISION RECEIVERS, 1922-1959, COMPARED TO PURCHASES BY THE U.S. PUBLIC SCHOOLS
(in thousands)

TABLE XV

	Radio Receivers				Television Receivers			
	Production[1]		Public School Purchases[2]		Production[1]		Public School Purchases[2]	
Year	Annual	Total	Annual	Total	Annual	Total	Annual	To
1922	100	100						
1923	500	600						
1924	1,500	2,100						
1925	2,000	4,100						
1926	1,750	5,850						
1927	2,350	8,200						
1928	3,250	11,450						
1929	4,428	15,875						
1930	3,789	19,667						
1931	3,594	23,261						
1932	2,446	25,707						
1933	4,157	29,864						
1934	4,479	34,343						
1935	6,030	40,373						
1936	8,249	48,622		10				
1937	8,083	56,705	3	13				
1938	7,142	63,847	3	16				
1939	10,763	74,610	3	18				
1940	11,831	86,441	4	21				
1941	13,642	100,083	2	23				
1942	4,307	104,390	2	25				
1943			1	26				
1944			1	27				
1945			1	28				
1946	15,955	120,345	1	29				
1947	20,000	140,345	2	31	179	179		
1948	16,500	156,845	5	36	975	1,154		
1949	11,400	168,245	7	43	3,000	4,154		
1950	13,468	181,713	10	53	7,464	11,617		
1951	11,928	193,641	16	69	5,385	17,002		
1952	10,969	204,610	15	84	6,096	23,098		
1953	13,343	217,953	10	94	7,216	30,314		1
1954	10,386	228,339	5	99	7,347	37,661	1	2
1955	14,526	242,865	2	101	7,757	45.418	2	4
1956	13,969	256,834	1	102	7,387	52.805	5	9
1957	15,446	272,280	1	103	6,399	59,204	6	15
1958	12,507	284,787	1	104	4,920	64,124	9	24
1959	16,451	301,238	0	104	6,349	70,474	10	34

[1] Production figures are taken directly from the Electronics Industry 1960 Fact Book (16).

[2] Public school purchases are figures of the Technological Development Project based on survey data.

TABLE XVI

TELEVISION BROADCASTING STATIONS, 1941-1961

Year	Commercial Television Stations[1]	Educational Television Stations[2]
1941	2	
1942	4	
1943	4	
1944	6	
1945	6	
1946	6	
1947	7	
1948	17	
1949	50	
1950	97	
1951	107	
1952	108	
1953	125	2
1954	349	10
1955	411	17
1956	442	22
1957	471	28
1958	492	36
1959	509	45
1960	517	52
1961	530	63[3]

[1] Figures for 1941-56 from The Historical Statistics of the United States (65) Table Series R 90-98, p. 491, and supplemented for the years 1957-61 from the Statistical Abstract of the United States 1961 Edition (66), Table 690, p. 514.

[2] Powell, J.W., Channels of Learning, p. 122-125 (51).

[3] Ibid., p. 122. "at the end of 1961 the 63 ETV stations that were expected to be in operation included:

22 operated by institutions or Boards of Higher Education, in 17 states;

16 operated by city, county, or state boards of public instruction in 13 states;

5 under state television authorities devoted to public instruction;

1 licensed to a public library; and

19 run by community corporations in 13 states and the Dis. of Col."

TABLE XVII

AVERAGE PRICE OF 16 MM SOUND FILM PROJECTORS, 1931-1962[1]

	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944
AMPRO	575	575		650	650	454	461	396	378	371	338	322	351	367
APPOLO														
C O BAPTISTA														
BELL & HOWELL				700	787	603	604	496	473	459	552	514	421	421
DE VRY					665	665	665	558	558	558	560	560	560	560
EASTMAN KODAK											405	405	393	373
FORWAY														
GRAFLEX														
KOLOGRAPH														
MOVIE MITE								179	179	179	190	190		
NATCO														
RCA		300	390	488	488					300	300			
REVERE														
TSI														
VICTOR			453	483	450	437	475	410	410	288	343	365	454	454
Number of Companies	1	2	2	4	5	4	4	5	5	6	7	6	5	5
Average Price in Actual Dollars	575	438	422	580	608	540	551	410	400	359	384	393	436	435
Consumer Price Index (1947-49 = 100)	65.0	58.4	55.3	57.2	58.7	59.3		60.3		59.9		69.7		75.2
Average Price in 1949 Dollars		750		1014		911		680		600		564		578

(TABLE XVII)

	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
AMPRO	405	463	490	382	442	474	474	474	564	579	495	484	484					
APPOLO					150	150	150	150	150									
C O BAPTISTA				475			495				495	575	575	575				
BELL & HOWELL	426	483	586	512	527	563	563	561	571	571	566	473	473	500	487	618	538	625
DE VRY	560	560	560	558	457	457	457	500	500	486								
EASTMAN KODAK	412	358	370	434	401	401	375	425	425	433	470	415	415	529	496	537	532	571
FORWAY				345	370	385	516	432	432	442	465	465	465	482	482	482	482	483
GRAFLEX														460	474	479	479	535
KOLOGRAPH				485	485	635	685	685										
MOVIE MITE		278	288	204	264	264	264	276	276	276		299	299	499	350	350	424	450
NATCO	479	485	483	439	375	375	375											
RCA	542	542	542	435	517	526	518	518	518	518	530	518	518	537	537	537	553	560
REVERE			325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	325
TSI											464	462	462	462	510	523	541	
VICTOR	454	454	432	408	407	415	433	423	447	467	468	491	491	531	531	538	557	575
Number of Companies	7	8	9	12	12	12	13	11	10	9	9	10	10	10	9	9	9	8
Average Price in Actual Dollars	468	453	453	425	402	514	425	434	421	455	475	451	451	490	466	488	492	516
Consumer Price Index (1947-49 = 100)		83.4		102.8		102.8		113.5		114.8		116.2		123.5		126.5		128.4
Average Price in 1949 Dollars		543		413		403		382		396		388		397		386		402

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[1] Cost information 1931-1954 is obtained from The Blue Book of Audio Visual Equipment, and supplemented from the eight editions of The Audio-Visual Directory (47) for the years 1947-1962. The average yearly price for each manufacturer is obtained by averaging the prices of the several models available for that year. Where a manufacturer was represented for only one year (Hanimex in 1958, Marcellus in 1959) they are excluded from the table. Also, the Bell & Howell JAN projector is not included because it represents a new engineering concept and does not conform to the general price structure.

TABLE XIX

AN INDEX TO CUMULATIVE GROWTH OF AUDIO-VISUAL EQUIPMENT IN THE PUBLIC SCHOOLS, 1936-1962

(in thousands of dollars at 1962 replacement cost)

Year	M.P. Proj.	Slide/ F.S.	Opaque Proj.	O.H. Proj.	Radio	Record Players	Tape Recorder	T.V. Sets	Language Labs	Cumulative Total
1936	250	500	600		1,000	3,000				5,350
1937	900	620	930		1,300	3,040				6,790
1938	1,900	730	1,230		1,560	3,070				8,490
1939	3,400	850	1,560		1,820	3,110				10,740
1940	5,750	960	1,860		2,100	3,140				13,810
1941	7,150	1,080	2,190		2,300	3,180				15,900
1942	7,250	1,190	2,520		2,480	3,210				16,650
1943	7,350	1,720	2,820		2,600	3,250				17,740
1944	7,450	2,250	3,150		2,700	3,280				18,830
1945	7,550	2,780	3,450		2,800	3,320				19,900
1946	8,800	2,840	3,780		2,900	3,350				21,670
1947	11,450	2,860	4,110		3,100	3,500				25,020
1948	15,550	2,970	4,410		3,550	3,720				30,200
1949	18,700	3,150	4,680		4,290	4,030				34,850
1950	21,500	3,600	4,860		5,300	4,420				39,680
1951	25,300	4,160	4,950		6,900	4,980	80			46,370
1952	30,800	4,840	5,040		8,440	5,600	360	100		55,180
1953	36,350	5,630	5,190		9,400	6,440	820	250		64,080
1954	42,150	6,540	5,460	630	9,910	7,850	1,540	475	75	74,630
1955	48,050	7,560	5,880	1,080	10,100	9,860	2,500	1,050	150	86,230
1956	52,950	8,660	6,360	1,620	10,210	12,280	3,600	2,125	225	198,030
1957	55,700	9,890	7,170	2,250	10,300	17,110	5,040	3,750	525	111,735
1958	57,500	11,650	8,070	2,970	10,350	20,900	7,060	6,000	5,550	130,050
1959	61,150	13,560	9,330	3,840	10,400	24,700	9,900	8,500	17,250	158,630
1960	65,050	15,640	10,800	4,980	10,450	28,550	13,380	11,250	42,750	202,850
1961	68,350	17,640	12,360	6,060	10,500	32,290	17,520	14,000	58,550	237,270
1962	72,500	19,640	13,980	7,200	10,550	36,000	20,600	17,000	75,000	272,470

TABLE XX

COMPARATIVE GROWTH FIGURES FOR AUDIO-VISUAL EQUIPMENT IN THE PUBLIC SCHOOLS, 1936-1962

(in thousands)

Year	PROJECTION EQUIPMENT				ELECTRONIC EQUIPMENT					
	16mm Sound	Slide F.S.	Opaque	Overhead	Radio Receivers	Record Players	Tape Recorders	Television Receivers	Central Sound Systems	Language Labs
1936	0.5	5.0	2.0	-	10.0	30.0	-	-	0.8	-
1937	1.8	6.2	3.1	-	13.0	30.4	-	-	1.0	-
1938	3.8	7.3	4.1	-	15.6	30.7	-	-	1.3	-
1939	6.8	8.5	5.2	-	18.2	31.6	-	-	1.5	-
1940	11.5	9.6	6.2	-	21.0	31.4	-	-	1.8	-
1941	14.3	10.8	7.3	-	23.0	31.8	-	-	2.0	-
1942	14.5	11.9	8.4	-	24.8	32.1	-	-	2.2	-
1943	14.7	17.2	9.4	-	26.0	32.5	-	-	2.5	-
1944	14.9	22.5	10.5	-	27.0	32.8	-	-	2.7	-
1945	15.1	27.8	11.5	-	28.0	33.2	-	-	3.0	-
1946	17.6	28.4	12.6	-	29.0	33.5	-	-	3.2	-
1947	22.9	28.6	13.7	-	31.0	35.0	-	-	3.9	-
1948	31.1	29.7	14.7	-	35.5	37.2	-	-	4.8	-
1949	37.4	31.5	15.6	-	42.9	40.3	-	-	5.8	-
1950	43.0	36.0	16.2	-	53.0	44.2	-	-	6.9	-
1951	50.6	41.6	16.5	-	69.0	49.8	0.4	-	7.9	-
1952	61.1	48.4	16.8	-	84.4	56.0	1.8	0.4	9.1	-
1953	72.7	56.3	17.3	-	94.0	64.4	4.1	1.0	10.1	-
1954	84.3	65.4	18.2	2.1	99.1	78.5	7.7	1.9	11.0	.01
1955	96.1	75.6	19.6	3.6	101.0	98.6	12.5	4.2	12.2	.02
1956	105.9	86.6	21.2	5.4	102.1	122.8	18.0	8.5	13.5	.03
1957	111.4	98.9	23.9	7.5	103.0	171.1	25.2	15.0	15.8	.07
1958	115.0	116.5	26.9	9.9	103.5	209.0	35.3	24.0	18.4	.74
1959	122.3	135.6	31.1	12.8	104.0	247.0	49.5	34.0	21.4	2.3
1960	130.1	156.4	36.0	16.6	104.5	285.5	66.9	45.0	25.1	5.7
1961	136.7	176.4	41.2	20.2	105.0	322.9	87.6	56.0	28.4	7.8
1962	145.0	196.4	46.6	24.0	105.5	360.0	103.0	68.0	31.5	10.0

TABLE XXI

NUMBER OF TEACHERS PER UNIT OF AUDIO-VISUAL EQUIPMENT IN THE U.S. PUBLIC SCHOOLS, 1946-1962

Year	16mm M.P.	Slide F.S.	Opaque Proj.	O.H. Proj.	Radio	Record Players	Tape Rec.	T.V. Sets	Central Sound Systems	Language Labs
1946	47.2	29.3	66.0		28.7	24.8			259.7	
1948	27.7	29.0	58.2		24.3	23.1			172.2	
1950	21.3	25.4	56.4		17.2	20.7			130.6	
1952	15.8	19.9	57.3		11.3	17.2	535.0		107.0	
1954	12.4	15.9	58.7	267.0	10.8	11.4	138.7	593.3	97.1	
1956	10.9	13.3	54.5	213.8	11.3	9.4	64.1	135.8	85.5	
1958	11.0	10.9	47.1	127.9	12.2	6.1	35.8	52.8	68.8	1711.6
1960	10.8	9.0	39.2	84.9	13.4	4.9	21.1	31.3	56.2	247.4
1962	10.1	7.4	31.4	61.0	13.9	4.1	14.2	21.5	46.4	146.3

TABLE XXII

NUMBER OF UNITS OF AUDIO-VISUAL EQUIPMENT PER 100 TEACHERS IN THE U.S. PUBLIC SCHOOLS 1946-1962

Year	16mm M.P.	Slide F.S.	Opaque Proj.	O.H. Proj.	Radio	Record Players	Tape Rec.	T.V. Sets	Central Sound Systems	Language Labs
1946	2.1	3.4	1.5		3.5	4.0			.4	
1948	3.6	3.4	1.7		4.1	4.3			.6	
1950	4.7	4.0	1.8		5.8	4.8			.8	
1952	6.3	5.0	1.7		8.8	5.8	.2		.9	
1954	8.1	6.3	1.7	0.2	9.3	7.5	.7	.2	1.0	
1956	9.2	7.5	1.8	0.5	8.8	10.6	1.6	.7	1.2	
1958	9.1	9.2	2.1	0.8	8.2	16.5	2.8	1.9	1.5	.01
1960	9.2	11.1	2.6	1.2	7.5	20.2	4.7	3.2	1.8	.40
1962	9.9	13.4	3.2	1.6	7.2	24.6	7.0	4.6	2.2	.68

TABLE XXIII

COMPARATIVE TEACHER-EQUIPMENT RATIOS 1960-1962
(in number of teachers per unit of equipment)

	Local Surveys[1]						National Surveys		
	Los Angeles County (20 districts)[2] 1962				Los Angeles City Schools[3] 1962	St. Louis Suburban Schools [4] 1962	Godfrey (B.S.S.R.) Survey[5] 1961	Technological Development Project	
Equipment	(6 elem)	(3 H.S.)	(11 unified)	(total)				1960	1962
16mm Projector	11.3	6.9	10.2	9.7	7.9	9.3	11.3	10.8	10.1
Slide/Filmstrip	9.4	9.1	11.1	10.3	6.0	8.2	8.2	9.0	7.4
Opaque Proj.	34.6	57.8	41.6	41.4	152.2	29.7	26.5	39.2	31.4
Overhead Proj.	288.2	28.9	50.1	54.8	91.3	123.7	99.6	84.9	61.0
Radio Receiver	6.8	7.4	7.7	8.4	3.8	13.4	13.6	13.4	13.9
Record Player	2.2	9.6	3.3	3.2	3.0	3.7	4.0	4.9	4.1
Tape Recorder	17.3	52.3	11.2	11.9	9.1	12.3	16.4	21.1	14.2
TV Receiver	10.7	-	14.9	15.1	22.8	12.3	28.2	31.1	21.5
Central Sound	-	-	-	-	65.2	50.3	50.7	56.2	46.4
Language Lab.	-	-	-	-	2075.7	352.0	216.6	247.4	146.3

[1] K. C. Rugg, Improving Instruction (57) provides information showing the following teacher/16mm projector ratios for 7 school districts in 1959: 5/1, 8/1, 10/1, 13/1, 15.7/1, 16.4/1.

[2] Robert C. Gerletti, Los Angeles County Schools Audio-Visual Department (interview).

[3] Dale Eymann, Los Angeles City School District, Audio-Visual Department (interview).

[4] Paul Andereck, St. Louis Suburban Schools, Audio-Visual Education Department (5).

[5] Eleanor Godfrey, A Study of Audio-Visual Media in the Public Schools (30).